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SAMPLING AND ANALYSIS PLAN FOR EXCAVATION OF CONTAMINATED SOIL AT UNDERGROUND STORAGE TANK 7 NS MAYPORT FL

2/1/2006

TN & ASSOCIATES

SAMPLING AND ANALYSIS PLAN

EXCAVATION OF CONTAMINATED SOIL
AT UST 7
NS MAYPORT, FLORIDA
N62467-02-D-0483/013

Prepared for:

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Southern Division
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Engineering and Science

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LIST OF ACRONYMS

%R	percent recovery
ARAR	applicable or relevant and appropriate requirement
COC	chain-of-custody
DO	delivery order
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectroscopy
IDW	investigative-derived waste
LCS	laboratory control sample
MS	matrix spike
MSD	matrix spike duplicate
OSWER	Office of Solid Waste and Emergency Response
PARCC	precision, accuracy, representativeness, completeness, and comparability
QA	quality assurance
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SOW	Scope of Work
TCL	target compound list
TN&A	T N & Associates, Inc.
TSD	treatment, storage, and disposal

1.0 PROJECT DESCRIPTION

See Section 3 of the Work Plan for a complete discussion of the project including:

- Scoping and Plan
- Site Management
- Quality Control
- Site Mobilization
- Site Preparation
- Soil Excavation
- Transportation and Disposal
- Backfill Sampling and Analysis and Placement
- Site Restoration

2.0 CHEMICAL DATA QUALITY OBJECTIVES

2.1 Project Objectives

The objective of the Sampling and Analysis Plan (SAP) is to facilitate project implementation while complying with the project Data Quality Objectives (DQOs). The SAP provides an internal means for control and review so that the environmentally related measurements and data collected by TN & Associates, Inc., (TN&A) and its subcontractors are technically sound, scientifically and legally defensible, and of known, acceptable, and documented quality. This project has several general quality assurance (QA) objectives.

- Scientific data generated will be of sufficient quality to withstand scientific and legal scrutiny.
- Data will be gathered or developed in accordance with procedures appropriate for its intended use.
- Data will be of known precision, accuracy, representativeness, completeness, and comparability (PARCC) within the limits of the scope of the project.
- Quantitation (reporting) limits for analysis methods will fall at or below applicable or relevant and appropriate requirements (ARARs) for all potential site contaminants.

2.2 Data Quality Objectives

All analytical results will be evaluated in accordance with PARCC parameters to support the attainment of project specific DQOs. Of these PARCC parameters, precision and accuracy will be evaluated quantitatively through the collection of the quality control (QC) samples listed in Table 2.1. Laboratory established precision and accuracy goals for these QC samples are listed in Tables 2.2 through 2.14.

Table 2.1
Quality Control Samples for Precision and Accuracy

QC TYPE	Precision	Accuracy	Frequency
Laboratory QC	MS/MSD (RPD); Field duplicate (RPD)	MS/MSD (%R) Method Blanks LCS or Blank Spikes Surrogate (%R) Internal Standards (%R)	MS/MSD = 1/20 samples Method Blank = 1/20 samples LCS[a] or Blank Spikes = 1/20 samples Surrogate and Internal Standard (every sample as prescribed by applicable method)

a) LCS duplicates will be prepared for the laboratory batch QC whenever MS/MSD preparations cannot be performed

%R Percent recovery
LCS Laboratory control sample
MS/MSD Matrix spike/matrix spike duplicate
RPD Relative percent difference

Representative data will be obtained through careful selection of sampling location and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination. Following established field and laboratory procedures will also support the collection of representative data. To aid in evaluating of the representativeness of the sample results, laboratory blank samples will be evaluated for the presence of contaminants. Data determined to be non-representative, by comparison with existing data, will be used only if accompanied by appropriate qualifiers and limits of uncertainty. The list of analytical methods prescribed for this project is shown in following tables.

Comparability expresses the confidence with which one data set can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data.

Table 2.2

Precision and Accuracy for Volatile Organics in Soil by Method 8260B

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Acetone	50	51-136	14-140	33
Benzene	5.0	74-124	63-135	23
Bromodichloromethane	5.0	74-124	63-126	23
Bromoform	5.0	79-127	54-109	24
Chlorobenzene	5.0	78-117	64-130	24
Chloroethane	5.0	63-147	53-172	28
Chloroform	5.0	75-121	68-131	24
Carbon Disulfide	5.0	59-148	47-165	29
Carbon Tetrachloride	5.0	67-131	64-148	24
1,1-Dichloroethane	5.0	71-118	64-130	25
1,1-Dichloroethylene	5.0	64-126	55-149	28
1,2-Dichloroethane	5.0	72-120	60-114	22
1,2-Dichloropropane	5.0	74-126	65-128	23
Dibromochloromethane	5.0	78-120	60-119	23
Cis-1,2-Dichloroethylene	5.0	75-124	66-132	24
Cis-1,3-Dichloropropene	5.0	72-120	57-118	25
Trans-1,2-Dichloroethylene	5.0	70-122	63-137	27
Trans-1,3-Dichloropropene	5.0	75-118	58-115	25
Ethylbenzene	5.0	77-120	63-142	25
2-Hexanone	25	68-136	35-109	34
4-Methyl-2-Pentanone	25	69-136	44-99	32
Methyl Bromide	5.0	52-156	38-188	27
Methyl Chloride	5.0	63-142	57-160	29
Methylene Chloride	10	51-142	40-183	34
Methyl Ethyl Ketone	25	63-138	27-112	32
Styrene	5.0	74-120	54-130	26
1,1,1-Trichloroethane	5.0	70-131	70-149	25
1,1,2.2-Tetrachloroethane	5.0	76-121	45-121	33
1,1,2-Trichloroethane	5.0	77-118	60-114	25

Table 2.2

Precision and Accuracy for Volatile Organics in Soil by Method 8260B

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Tetrachloroethylene	5.0	68-127	54-154	27
Toluene	5.0	74-118	62-142	29
Trichloroethylene	5.0	72-122	59-143	25
Vinyl Chloride	5.0	64-144	64-165	27
Xylene (total)	15	78-122	64-142	24
Surrogates				
Dibromofluoromethane	N/A	78-123	78-123	N/A
Toluene-d8	N/A	71-137	71-137	N/A
4-Bromofluorobenzene	N/A	61-157	61-157	N/A
1,2-Dichloroethane-d4	N/A	74-125	74-125	N/A

Table 2.3

Precision and Accuracy for Semi-Volatile Organics in Soil by Method 8270C

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Benzoic acid	830	43-117	19-117	34
2-Chlorophenol	170	70-102	54-104	18
4-Chloro3-methyl phenol	170	70-103	57-107	17
2,4-Dichlorophenol	170	70-101	49-108	20
2,4-Dimethylphenol	170	39-100	42-94	25
2,4-Dinitrophenol	830	34-131	22-114	22
4,6-Dinitro-o-cresol	330	55-122	35-117	25
2-Methylphenol	170	66-100	54-100	18
3&4-Methylphenol	170	68-100	55-102	18
2-Nitrophenol	170	70-102	48-108	19
4-Nitrophenol	830	63-112	46-116	15
Pentachlorophenol	830	58-111	45-112	16
Phenol	170	68-99	54-104	17
2,4,5-Trichlorophenol	170	72-103	56-108	23
2,4,6-Trichlorophenol	170	68-100	57-102	14

Table 2.3

Precision and Accuracy for Semi-Volatile Organics in Soil by Method 8270C

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Acenaphthene	170	73-100	57-108	19
Acenaphthylene	170	82-111	60-120	17
Anthracene	170	76-106	68-105	16
Benzo(a)anthracene	170	76-105	69-104	24
Benzo(a)pyrene	170	74-116	66-114	26
Benzo(b)fluoroanthene	170	73-114	64-113	19
Benzo(g,h,i)perylene	170	67-115	44-133	23
Benzo(k)fluoroanthene	170	72-115	63-111	23
4-Bromophenyl phenyl ether	170	76-102	67-102	15
Butyl benzyl phthalate	330	70-111	61-113	16
Benzyl alcohol	170	69-111	57-111	17
2-Chloronaphthalene	170	73-101	60-103	15
4-Chloroaniline	330	18-101	22-104	27
Carbazole	170	74-113	70-109	21
Chrysene	170	76-102	68-102	25
Bis (2-Chloroethoxy)methane	170	61-101	50-100	19
Bis (2-Chloroethyl)ether	170	70-103	56-105	20
Bis (2-Chloroisopropyl)ether	170	61-113	48-112	18
4-Chlorophenyl phenyl ether	170	75-103	64-105	13
1,2-Dichlorobenzene	170	69-101	55-99	18
1,3-Dichlorobenzene	170	67-100	53-98	19
1,4-Dichlorobenzene	170	69-100	55-99	19
2,4-Dinitrotoluene	170	74-112	66-107	14
2,6-Dinitrotoluene	170	74-114	67-110	13
3,3'-Dichlorobenzidine	330	30-102	25-103	24
Dibenzo(a,h)anthracene	170	66-116	48-130	21
Dibenzofuran	170	75-101	65-102	13
Di-n-butyl phthalate	330	75-109	62-114	16
Di-n-octyl phthalate	330	64-128	61-120	18
Diethyl phthalate	330	75-109	67-104	13
Dimethyl phthalate	330	76-106	66-104	13

Table 2.3

Precision and Accuracy for Semi-Volatile Organics in Soil by Method 8270C

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Bis (2-Ethlhexyl)phthalate	330	69-115	62-115	16
Fluoranthene	170	76-112	58-122	22
Fluorene	170	75-105	64-107	21
Hexachlorobenzene	170	76-103	66-103	16
Hexachlorobutadiene	170	62-91	49-90	18
Hexachlorocyclopentadiene	170	33-112	10-99	34
Hexachloroethane	170	68-104	51-103	19
Indeno(1,2,3-cd)pyrene	170	67-119	48-132	23
Isophorone	170	74-103	61-104	17
2-Methylnaphthalene	170	71-100	59-99	21
2-Nitroaniline	330	75-109	65-109	14
3-Nitroaniline	330	47-103	44-98	21
4-Nitroaniline	330	60-113	54-109	19
Naphthalene	170	73-100	59-100	21
Nitrobenzene	170	73-101	59-102	18
N-Nitroso-di-n-propylamine	170	69-104	55-106	19
N-Nitrosodiphenylamine	170	80-113	69-116	16
Phenanthrene	170	76-104	65-105	24
Pyrene	170	70-106	62-107	26
1,2,4-Trichlorobenzene	170	72-100	58-101	17
Surrogates				
2-Fluorophenol (surr)	N/A	45-114	45-114	N/A
Phenol-d5 (surr)	N/A	44-124	44-124	N/A
2,4,6-Tribromophenol (surr)	N/A	50-128	50-128	N/A
2-Fluorobiphenyl (surr)	N/A	41-123	41-123	N/A
Nitrobenzene-d5 (surr)	N/A	46-122	46-122	N/A
Terphenyl-d14 (surr)	N/A	45-135	45-135	N/A

Table 2.4

Precision and Accuracy for Polychlorinated Biphenyls in Soil by Method 8082

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Aroclor 1016	17	75-123	54-138	22
Aroclor 1221	17	N/A	N/A	N/A
Aroclor 1232	17	N/A	N/A	N/A
Aroclor 1242	17	N/A	N/A	N/A
Aroclor 1248	17	N/A	N/A	N/A
Aroclor 1254	17	N/A	N/A	N/A
Aroclor 1260	17	72-124	46-138	21
Surrogates				
Tetrachloro-m-xylene (surr)	N/A	52-136	52-136	N/A
Decachlorobiphenyl (surr)	N/A	49-148	49-148	N/A

Table 2.5

Precision and Accuracy for Metals in Soil by Method 6010B/7471A

Parameter	RL (mg/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Aluminum	20.00	80-120	75-125	20
Antimony	6.00	80-120	75-125	20
Arsenic	0.50	80-120	75-113	20
Barium	20.00	80-120	75-122	20
Beryllium	0.50	80-120	75-120	20
Cadmium	0.40	80-120	75-116	20
Calcium	500.00	80-120	75-125	20
Chromium	1.00	80-120	75-125	20
Cobalt	5.00	80-120	80-112	20
Iron	10.00	80-120	75-125	20
Lead	10.00	80-120	75-121	20
Magnesium	500.00	80-120	75-125	20
Manganese	1.50	80-120	75-125	20

Table 2.5

Precision and Accuracy for Metals in Soil by Method 6010B/7471A

Parameter	RL (mg/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Mercury	0.17	*80-120*	*47-157*	20
Nickel	4.00	80-120	75-122	20
Potassium	500.00	80-120	75-125	20
Selenium	10.00	80-120	75-110	20
Silver	1.00	80-120	75-120	20
Sodium	500.00	80-120	75-125	20
Thallium	10.00	80-120	75-118	20
Vanadium	5.00	80-120	80-118	20
Zinc	2.00	80-120	75-125	20

Table 2.6

Precision and Accuracy for Pesticides in Soil by Method 8081A

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Aldrin	1.7	67-130	57-142	23
Alpha-BHC	1.7	70-135	53-147	24
Beta-BHC	1.7	75-130	58-152	18
Delta-BHC	1.7	53-126	37-148	23
Gamma-BHC (Lindane)	1.7	73-136	59-146	21
Alpha-Chlordane	1.7	78-129	59-147	21
Gamma-Chlordane	1.7	78-132	55-152	20
Dieldrin	1.7	79-136	59-142	20
4,4’-DDD	3.3	76-142	56-167	25
4,4’-DDE	3.3	78-143	58-158	21
4,4’-DDT	3.3	84-141	60-157	25
Endrin	3.3	79-138	59-153	21
Endosulfan Sulfate	3.3	78-128	52-151	24
Endrin Aldehyde	3.3	5-103	5-106	50
Endrin Ketone	3.3	79-129	44-163	22

Table 2.6

Precision and Accuracy for Pesticides in Soil by Method 8081A

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
Endosulfan-I	1.7	79-128	57-145	20
Endosulfan-II	3.3	78-132	52-146	22
Heptachlor	1.7	71-136	61-145	24
Heptachlor Epoxide	1.7	76-133	58-147	20
Methoxychlor	3.3	81-137	58-154	25
Toxaphene	170	50-150	50-150	20
Surrogates				
Tetrachloro-m-xylene	N/A	60-142	60-142	N/A
Decachlorobiphenyl	N/A	61-153	61-153	N/A

Table 2.7

Precision and Accuracy for Herbicides in Soil by Method 8151A

Parameter	RL (ug/Kg)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
2,4-D	33	25-144	24-144	30
2,4,5-TP (Silvex)	6.6	28-119	26-113	28
2,4,5-T	6.6	19-135	23-132	29
Dicamba	6.6	36-110	23-122	28
Dinoseb	6.6	10-25	10-37	27
Dalapon	33	18-119	34-106	30
Dichloroprop	33	39-121	39-116	27
2,4-DB	66	22-132	31-124	27
MCPP	1,700	N/A	N/A	N/A
MCPA	1,700	N/A	N/A	N/A
Pentachlorophenol	1.7	26-105	17-124	28
Surrogates				
2,4-DCAA	N/A	10-140	10-140	N/A

Table 2.8

Precision and Accuracy for TRPH in Soil by Method FL-PRO

Parameter	RL (PPM)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
TRPH	180	69-112	36-132	20

Table 2.9

Precision and Accuracy for pH in Soil by Method 9045B

Parameter	RL (std unit)	LCS Accuracy % Recovery	MS/MSD Accuracy % Recovery	RPD Limits
PH	0.01	N/A	N/A	N/A

2.3 Analytical Methodologies

All laboratory analyses conducted on samples collected during this project are subject to general QC requirements, which are itemized here.

- Holding times and the amount of sample submitted for testing must be reviewed to prioritize sample analyses. Analyses must be performed within holding times according to method procedures.
- Initial calibration will be performed as specified in the analytical method [including the use of at least one calibration standard at or below the laboratory practical quantification limit], using at least three standards and a reagent blank, unless otherwise specified in the analytical method. Continuing calibration will be performed as specified in the analytical method. For gas chromatograph (GC)/mass spectroscopy (MS) methods, instrument tune will be verified as specified in the analytical method.
- Each analytical batch (up to 20 samples) must include at least one method blank, prepared and analyzed using the same reagents, equipment, instruments, and procedures as the batch samples; if sufficient sample volume is available one matrix spike/matrix spike duplicate (MS/MSD) pair will be prepared and analyzed with each analytical batch (up to 20 samples), or for each significantly different (e.g., soil, groundwater, waste, wastewater) sample matrix included in an analytical batch, unless not specified in the method. At least one laboratory control sample (LCS), prepared in analyte-free water for aqueous analyses or Ottawa sand for soil analyses, and spiked with all method analytes must be analyzed with each analytical batch. The LCS will be spiked at a level less than or equal to the mid-point of the calibration curve for each analyte. The LCS will be carried through the complete sample preparation and analysis procedure. If MS/MSD are not included then a LCS duplicate will be prepared and analyzed with the laboratory batch.

Table 2.10 identifies the analytical methods that may be used for analysis of samples collected from the backfill to be utilized at UST 7 NS Mayport. The subcontract laboratory for waste disposal analysis is expected to be Test America. Should TN&Associates designated laboratory be unable to perform the required analysis requested by TN&Associates another equally qualified laboratory that will be Navy certified for the analyses that are to be performed will be selected.

Table 2.10
Analytical Methods

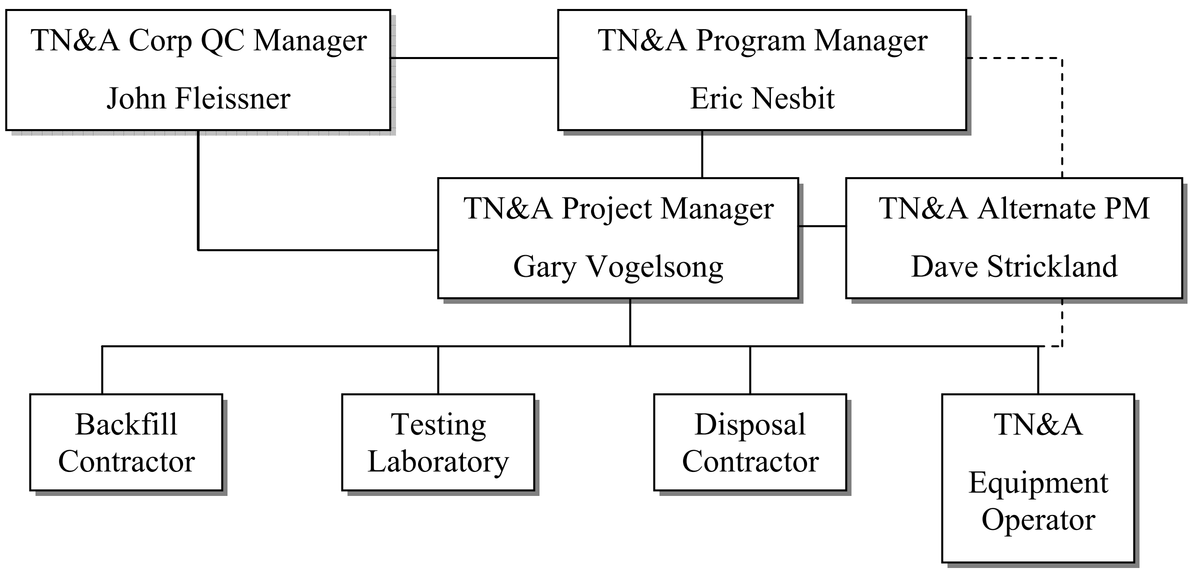
Matrix	Analysis	Preparation Method	Analysis Method	Parameter List\b
Soil / Solids	Volatiles	SW5035A	SW8260B	TCL List Volatiles
	Semivolatiles	SW3550	SW8270C	TCL List Semivolatiles
	TRPH	SW3550	FL PRO	TRPH
	Metals	SW3050B	SW6010B/7471A	TAL Metals
	PCBs	SW3550	SW8082	PCBs
	Pesticides	SW3550	SW8081A	TCL Pesticides
	Herbicides	SW3550	SW8151A	Herbicides
	PH	None Required	SW9045B	pH

Notes:
a Test Methods for Evaluating Wastes, Physical/Chemical Methods (SW-846, Third Edition, Update IIIA)
b (TCL) Target Compound List

3.0 PROJECT ORGANIZATION AND FUNCTIONAL AREA RESPONSIBILITIES

Figure 3.1 illustrates the project organization chart. The following sections identify key individuals that will be assigned to this project and describe the functions they will perform.

Figure 3.1
TN&A Project Organization Chart



3.1 Program Manager

The Program Manager, Mr. Eric Nesbit, is responsible for the quality of all work performed under this contract. He will monitor the overall progress of the delivery order (DO) to ensure that adequate resources are available and that major problems are prevented or minimized. Mr. Nesbit will concentrate of the technical quality, schedule, and cost for all work performed.

3.2 Project Manager

The Project Manager, Mr. Gary Vogelsong, has the primary responsibility and authority for managing the work and will oversee the coordination of the entire DO. Mr. Vogelsong is located in our Myrtle Beach, South Carolina office.

3.3 Subcontracted Vendors

Subcontractors, such as analytical laboratories and waste hauling contractors, must meet predetermined qualifications developed by the Project Manager. Each subcontractor bid submittal will be reviewed by technical, purchasing, and QA personnel to verify that the bidders are qualified and can satisfy bid requirements. Before a subcontractor starts work, TN&A will perform a quality check to determine if the subcontractor has fulfilled the procurement requirements necessary to begin activities. The Project Manager is responsible overall for subcontractor performance.

3.3.1 Offsite Laboratories

All subcontracted laboratory vendors must be in possession of a current Navy Laboratory Certification prior to receiving environmental samples.

TN & Associates' primary subcontracted laboratory is Test America. They will be performing the analyses required. The sample shipping address and the point of contact for the laboratory is:

Test America
2960 Foster Creighton Drive
Nashville, TN 37217
(615) 726-0177

3.4 Qualifications and Training of Personnel

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. In addition to minimum education and/or experience requirements specified in Appendix B of EM-200-1-3 for subcontract laboratory personnel, specific training may be required to qualify other project personnel to perform certain activities. The Project Manager is responsible overall for personnel training.

4.0 FIELD ACTIVITIES

4.1 Sampling

Soil samples will be collected for confirmation of clean backfill in accordance with Scope of work (SOW) #0030 and for soil disposal per Waste Management requirements. Table 4.1 shows the methods and sample quantities required.

Table 4.1
Summary of Soil Analyses

Location	Analysis	Methods	Sample Quantities				
			FS	FD	MS	MSD	Total
Backfill Confirmation Sampling	TCL volatiles	8260B	1	0	1	1	3
	TCL Semivolatiles	8270C	1	0	1	1	3
	TRPH	FL PRO	1	0	1	1	3
	TCL Pesticides	8081A	1	0	1	1	3
	Herbicides	8151A	1	0	1	1	3
	Total PCBs	8082	1	0	1	1	3
	TAL metals	6010A/7471A	1	0	1	1	3
	PH	9045B	1	0	1	1	3
Soil Disposal Characterization Sampling	TCL volatiles	8260B	5	0	1	1	7
	TCL Semivolatile	8270C	5	0	1	1	7
	TRPH	FL PRO	5	0	1	1	7
	Total PCBs	8082	5	0	1	1	7
	TAL metals	6010A/7471A	5	0	1	1	7
	PH	9045B	5	0	1	1	7

4.1.1.1 Sample Collection and Field and Laboratory Analysis

The samples will be sent to a subcontracted fixed-base laboratory for all analyses listed in Table 4.1 for backfill materials and soil disposal characterization. Quarterly monitoring well sampling will analyze for Gasoline Analytical Group and Kerosene Analytical Group parameters.

4.1.1.2 Samples and Frequency

Soil background samples will not be collected. Soil samples will be collected for backfill quality confirmation and for soil disposal characterization. Samples for post-excavation confirmation are not required and will not be collected.

Following submission of the Final Work Plan, TN&A staff will collect soil samples from each of the areas to be excavated utilizing hand augers. Three (3) to five (5) samples will be collected from the top twenty-four (24) inches of soil from each of the five (5) sites. Each site soil samples will be consolidated and homogenized for that site and a single sample sent to the laboratory for waste characterization for a total of five (5) individual waste characterizations. Characterization of the waste streams prior to mobilization will determine if the soils to be excavated are characterized as hazardous or non hazardous and will facilitate direct load out of excavated materials. Likewise, prior to utilizing the borrow source, a soil samples will be collected from the borrow source for chemical analysis to document its suitability as "clean" fill. The analytical results will be compared to the residential soil cleanup target levels in Chapter 62-777 Florida Administrative Code. The "clean" fill soil samples will be analyzed for chemicals of concern identified in SOW #0028. The reporting level for the analytical results will be U.S. Environmental Protection Agency (EPA) Level II.

O&M sampling of the monitoring well will be conducted on a quarterly basis beginning with the completion of field remediation activities.

4.1.1.3 Characterization Sampling

Sampling of soil for disposal characterization will be completed. Disposal requirements will be based on characterization data and is currently assumed to be Non-Hazardous based on the SOW-0028 details.

4.1.1.4 Backfill Sampling

For the analyses listed in Table 4.1, soil will be extracted from the three (3) locations designated as the backfill material source to be utilized for this project. The soil from each location will be mixed in a stainless steel bowl and a portion of the well-mixed composite material will be placed in a container for laboratory analysis. Additional sample volume (1 set of containers) will be collected for MS/MSD samples. The MS/MSD samples will be collected by filling a second container with well-mixed soil from the stainless steel bowl used for preparation/homogenization of the backfill sample collected.

4.1.2 Procedures

4.1.2.1 Sampling for Chemical Analyses

All soil samples will be collected in accordance with TN&A SOP TNFLD007D.

A stainless steel or Teflon™ sampling device will be used to remove soil from a specific depth to fill the required containers. The soil shall be placed in a clean stainless steel bowl and mixed thoroughly with stainless steel implements (spoons, spades, etc.), then divided among the sample containers to be filled and properly preserved. QC sample containers shall be collected from the same mixture.

Monitoring well sampling will take place using a peristaltic pump in accordance with Florida Department of Environmental Protection (FDEP) Standard Operating Procedure (SOP) FS2221, section 1.1, subparagraphs 1.1.1.1 through 1.1.1.13 and in accordance with TN&A SOP TNFLD0008F.

4.1.2.2 Sample Containers and Preservation Techniques

Samples will be collected in pre-cleaned, pre-preserved containers and placed into coolers containing ice upon sample collection. A summary of the sample containers, preservation, and holding time specifications is shown in Table 4.2. All samples will be handled in accordance with FDEP SOP FS1000, Tables FS1000-4 through FS1000-9. Samples will be identified and labeled in accordance with TN&A SOP TNFLD010C.

Table 4.2
Sample Container, Preservations, and Holding Times for Soil Samples

Analysis	Container[a]	Preservation	Extraction HT	Analysis HT
TRPH by FL PRO	8-oz jar	Chill to 4°C±2°C.	14 days	40 days from extraction
Volatile Organic Analyses	5035 Field Kit	2 vials H_2O, 1 vial MeOH	48 hours to freeze	14 days
Semivolatile Organic Analyses	8-oz jar	Chill to 4°C±2°C.	14 days	40 days from extraction
Polychlorinated Biphenyls	8-oz jar	Chill to 4°C±2°C.	14 days	40 days from extraction
TAL Metals		Chill to 4°C±2°C (optional)	180 days from sample collection, except Hg is 28 days	180 days from sample collection, except Hg is 28 days
Pesticides	8-oz jar	Chill to 4°C±2°C.	14 days	40 days from extraction
Herbicides	4-oz jar	Chill to 4°C±2°C.	14 days	40 days from extraction
PH	8-oz jar	Chill to 4°C±2°C.	ASAP	ASAP

a\ USEPA. April 1992. "Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers." Office of Solid Waste and Emergency Response (OSWER) Directive No. 9240.0-05A.

4.1.2.3 Decontamination Procedures

Decontamination of sampling equipment will be conducted in accordance with TN&A SOP TNFLD011A, using a potable water/soap scrub wash followed by a potable water rinse and two deionized water rinses. Decontaminated sampling equipment will be stored for later use in clean aluminum foil.

4.1.2.4 Sample Containers and Preservation Techniques

Samples will be collected in certified clean glass or plastic containers in accordance with FDEP SOP FC1300 and placed in an ice chest with ice upon sample collection.

5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

5.1 Field Logbook

Field logbooks will be prepared and maintained in accordance with TN&A SOP TNFLD002A.

5.2 Photographs

Not applicable.

5.3 Sample Numbering

All samples will be numbered in accordance with TN&A SOP TNFLD010C.

5.4 Sample Documentation

5.4.1 Sampling Labels and/or Tags

All samples will be labeled in accordance with TN&A SOP TNFLD010C. A copy of TNFLD010C is provided in "Attachment 1, Standard Operating Practices."

5.4.2 Sample Field Sheets and/or Logbook

All samples collected will be logged in accordance with TN&A SOPs TNFLD002A, 010C, and 011A. Copies of the TN&A SOPs are provided in "Attachment 1, Standard Operating Practices."

5.4.3 Chain of Custody Records

Custody of all samples will be documented from the time of collection until disposal using TN&A Chain of Custody (COC) Record forms. The appropriate pre-printed labels (or the appropriate sample number, type and number of container, preservative, requested analysis, and method information completed by hand) will be affixed to the COC Record forms in accordance with TN&A SOPs TNFLD002A and TNFLD010C.

5.4.4 Receipt for Sample Forms

Receipt for samples is documented on the TN&A COC Record

5.5 Documentation Procedures

All fieldwork and sampling will be documented in accordance with TN&A SOPs TNFLD002A and TNFLD010C.

5.6 Corrections to Documentation

All corrections to field logbooks and sampling documentation will be performed in accordance with TN&A SOPs TNFLD002A and TNFLD010C.

6.0 SAMPLE PACKAGING AND SHIPPING

All samples will be packaged for shipment to the laboratory in accordance with TN&A SOP TNFLD010C.

Samples collected during the site work are classified as environmental or hazardous. All sample shipping will be performed in accordance with U.S. Department of Transportation requirements as well as the provisions stated TN&A SOP TNFLD010C.

- Shipping containers shall be secured using strapping tape and custody seals to ensure that samples have not been disturbed during transport. The custody seals shall also be placed on each container so that they cannot be opened without breaking the seal. All openings will be taped shut to prevent potential leakage during transport.
- Shipment information will be recorded for each shipment of samples at the end of the shift, day, or collection period in the field logbooks and on all appropriate forms.

7.0 INVESTIGATION-DERIVED WASTE

The classification and characterization of all investigation-derived wastes (IDW) will be in accordance with the FDEP's Management of Contaminated Media under RCRA guidance document. All supporting documentation will be obtained to complete hazardous and/or non-hazardous waste manifests and obtain the services of permitted treatment, storage and disposal (TSD) facilities. With regard to the disposal of wastes from the site, the United States Navy – NAS Pensacola will be the generator as defined in 40 CFR 262. No TSD facility that is not operating under appropriate federal or state permits will be subcontracted. The TSD must be and is in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act Off-site Policy requirements concerning off-site disposal of wastes and approved by the US Navy. US Navy authorized agent will sign hazardous waste manifests necessary for off-site transportation and disposal as provided and otherwise properly completed by TN&A in accordance with the applicable regulations.

8.0 SAMPLING APPARATUS AND FIELD INSTRUMENTATION

The following equipment will be used for sampling in the field:

- Liquid sample collection equipment – pumps, bailers, etc.
- Stainless Steel Bowls
- Stainless Steel Spoons
- Aluminum Foil
- Phosphate Free Soap
- Deionized Water
- Disposable Gloves
- Coolers
- Ziploc Bags
- Garbage Bags
- Ice
- Packing Material
- Strapping Tape
- Custody Seals

ATTACHMENT 1

STANDARD OPERATING PRACTICES

STANDARD OPERATING PRACTICE TNFLD002A

Field Records and Documentation

TABLE OF CONTENTS

Field Records and Documentation

The objectives of this Standard Operating Practice (SOP) are to provide consistent procedures and formats by which field records will be kept and activities documented, and a methodology by which field records will be managed.

1.0 PROCEDURE

1.1 Materials

Materials to be used include:

- Field logbooks,
- Pens, containing indelible waterproof black ink,
- Field forms, and
- Watch with team-synchronized time (using the military 2400-hour format).

Bound, water-resistant field logbooks will only be used for the maintenance of field records (except for site specific reporting forms when required). The Project Manager prior to use must approve utilization of any other field logs.

1.2 General Requirements for Field Logbooks

Logbooks will be assigned by activity for the project until the specific activity is completed. The logbook for a specific activity will be used until the logbook is full. If the logbook for a specific activity is not filled completely, the logbook for that specific activity will be used for any future work of a similar nature e.g. quarterly groundwater sampling.

Each page of the logbook will be signed at the bottom, once filled or once field activities are completed. The logbooks will be turned in for copying/filing/tracking to the Project Manager.

The center of the front cover will be labeled with the project name and logbook number. The logbooks for each project will be sequentially numbered starting with the number one. Below the logbook number will be the activity that has been assigned and the date assigned.

All entries will be recorded in indelible, waterproof black ink. If errors are made in any field logbook, field record (form), chain-of-custody record, or any other field record document, corrections will be made by crossing a single line through the error, entering the correct information, initialing, and dating the correction.

A number of field forms have been adopted to facilitate the collection of consistent data. This will preclude detailed documentation of, for example, lithologic descriptions in the field logbook. A reference to each specific form must be made in the logbook.

Sufficient information will be recorded in the logbooks and on the field forms to permit reconstruction of all field activities conducted. While some duplication of information may occur between the type of logbooks and field forms, this activity will ensure that all required information is being recorded.

1.3 Format for Field Logbook Entries

Entries in field logbooks will be made in the following format:

The date will be placed in the top right-hand corner of every right page. The time of entry recordings will be in columnar form down the left-hand side of each page. All entries should be dated and the time of entry recorded.

At the beginning of each day, the first two entries will be "Personnel, Contractors On Site" and "Weather."

At the end of each day's entry or a particular event, if appropriate, the field person should draw a diagonal line originating from the bottom left corner of the conclusion of the entry to the bottom right corner of the page. The field person will sign along the line indicating the conclusion of the entry or the day's activity. At the end of the day's entry, the personnel should record the time of departure from the work site.

Language should be objective, clear, factual, and free of personal feelings or other terminology that might prove inappropriate, since field records are the basis for later written reports. Field logbooks are legal documents that must be maintained as part of the project files. The TN&A Project Manager should conduct periodic audits of field logbooks to ensure compliance with this SOP.

All aspects of sample collection and handling, as well as visual observations, will be documented in the field logbooks. All sample collection equipment, field analytical equipment, and equipment utilized to make physical measurements will be identified in the field logbooks. All calculations, results, and calibration data for field sampling, field analytical, field screening, and field physical measurements will also be recorded in the field logbooks, except where these are referenced as being recorded on approved field forms. All field analyses and measurements must be traceable to the specific piece of field equipment utilized and to the field investigator collecting the sample, making the measurement, or conducting analyses.

1.4 What to Record in the Field Logbook

Each field crew will be issued a field logbook in which detailed descriptions of all activities completed by the crew for each working day will be noted. The field logbooks will contain, at a minimum, the following:

- Name and title of the originator,
- Purpose of the field activity,
- Name, company name, and address of the site contact,
- Names and responsibilities of field crew members,
- Names and company name of all subcontract personnel,
- Names, titles, and association of any site visitors,
- Description of type and manufacturer of all heavy equipment used during field activities,

- Conversations with client representatives, senior TN&A personnel, landowners, regulatory agency representatives, etc.,
- Sample collection method,
- Quantity, location, and volume of sample(s) collected,
- Location, description, and log of photographs,
- References for all maps of the sampling site(s),
- Information regarding sampling changes, scheduling modifications and change orders,
- Information regarding drilling decisions (also recorded on the boring log),
- Information regarding sampling decisions,
- Information regarding access agreements, if applicable,
- Details of the sampling location, including a sketch map illustrating the sampling location (if not on the boring log),
- Equipment used,
- Date and time of sample collection and name of collector,
- Sample identification number(s),
- Information from containers, labels of reagents used, deionized and organic-free water used, etc.,
- Field analyses, conducted by whom, using what instruments or test kits,
- Field observations,
- All calculations and results,
- Extraordinary occurrences,
- Types of field instruments used and purpose of use, including calibration methods and results (if not on instrument calibration log),
- IDW documentation information including:
    - types of containers/drums,
    - contents, type, and approximate volume of waste,
    - type of contamination and predicted level of contamination based on available information,
- Shipping information, and
- Diagonal line with signature at end of logbook entry.

The last four pages of the logbook will be reserved for compiling a "List of Contents" for the logbook. Information recorded will include the project name and number, duration of involvement, brief description of activities, the page numbers in the logbook, the last page number copied to file, and date copied. The personnel assigned the logbook should update the "List of Contents" on a weekly basis.

1.5 Site Safety and Health Logbook

A separate Site Safety and Health (SSH) logbook may be maintained by the Site Safety and Health Officer (SSHO) to document all daily safety and health activities. If a separate SSH logbook is not required for a project, then the health and safety information should be recorded in the field logbook. The SSHO will be responsible for ensuring the following information is entered into the logbook:

- When the daily health and safety meeting/briefing was conducted (use daily form to record meeting topics and attendees),

- Daily health and safety site inspections,
- Daily inspection of field equipment,
- Weather, including general weather conditions, temperature, wind and direction,
- Major changes in weather conditions,
- Problems associated with field monitoring equipment,
- Detailed record of any health and safety incidents at the site, including any subcontractor incidents,
- Medical problems with any field team member, including anyone taking special medications, and
- Any visitors introduced at the site along with health and/or training records, as appropriate.

1.6 Field Forms

As appropriate, some or all of the field forms listed below will be distributed by the Field Team Leader (FTL) or designate team member to field personnel. The Field Team Leader will ensure that the forms are filled out correctly by the field team members:

FORMS:

Drilling Log

Well Construction Log

Well Development Log

Well/Boring Abandonment Log

Groundwater Sampling Log

Groundwater Level Measurement Log

Surface Water Sampling Log

Soil Gas Sampling Log

Decontamination Form

Chain-of-Custody Form

Field Equipment Calibration Form

Site Safety Health Plan (SSHP) Forms:

Air Monitoring Log

Daily Site Safety Briefing Form

Contractor SSHP Acceptance Form

Employee SSHP Acceptance Form

Visitor Sign-In

Project-specific forms should be listed in the project work plan or sampling and analysis plan.

1.7 Tracking of Field Records

Field records (logbooks and forms) tracking is the responsibility of the Field Team Leader during field operations. Following completion of the field event, the FTL will deliver the field records to the TN&A Project Manager.

The FTL shall compile the original field forms in a 3-ring notebook or secure file box during field operations. At the end of the fieldwork or phases of fieldwork, the FTL will send or deliver the field forms to the TN&A Project Manager at the project office. The on-site project personnel throughout the duration of the field program will maintain copies of the field forms.

1.8 Filing of Field Records

When an individual logbook is full or the activity is completed, the logbook will be submitted to the TN&A Project Manager within two working days for final cataloging and filing. The logbooks will be stored in the project file and will only be accessible to the Project Manager.

All non-bound field records (e.g., field forms, drilling logs) will be completed on the day the associated activity occurs and will be turned in to the FTL by the end of the day. The unbound daily field forms should be sent on at least a weekly basis to the Project Manager.

All field data collected using electronic data loggers or computer entry forms will be downloaded to a computer. If possible, the data will be downloaded on a daily basis by the person collecting the data. The Field Team Leader will be responsible for ensuring that all data collected are adequately represented in electronic media and in the project file. A hard copy of the data, and any graphical representation produced by logging software, will also be printed out and filed in the project file.

2.0 DAILY QUALITY CONTROL REPORTS

Daily Quality Control Reports (DQCRs) are an U.S. Army Corps of Engineers (USACE) requirement and may be used on other projects as well. DQCRs are completed daily by each field team. The purpose of these reports is to provide a written log of daily field activities to the TN&A Project Manager and client. Information on the DQCRs should be in a bulleted format (concise and brief). The information will include:

- Project, contract, and delivery order/task order numbers,
- Date (on each page of DQCR),
- Project name and location,
- Temperature range,
- Wind conditions,
- Personnel and subcontractors on-site,
- Equipment on-site,
- Summary of site activities,
- Level of health and safety protection,
- Field instruments used,
- Calibrations performed,
- Problems encountered,
- Corrective actions taken,

- Samples collected and collection methods (including sample IDs),
- QC samples collected (including sample IDs),
- Additional remarks, and
- Signature of person filling out DQCR.

DQCRs will be completed and faxed on a daily basis to the TN&A Project Manager. DQCRs are provided to the on-site USACE representative on a daily basis.

STANDARD OPERATING PRACTICE TNFLD007D

Subsurface Soil Sampling

1.0 OBJECTIVE

The objective of this procedure is to define the requirements for collecting subsurface soil samples.

2.0 BACKGROUND

For the purpose of this document, subsurface soil samples are those samples collected in the unconsolidated zone at a depth of 1-foot (ft) or greater below ground surface. Samples collected from ground surface down to 1 ft below ground surface are addressed in Standard Operating Practice (SOP) FLD006B, "Surface Soil Sampling." All operations at hazardous waste sites must be conducted in compliance with the provisions of Occupational Safety and Health Act (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 and all other state, local, and federal regulations.

Various methods are available to collect subsurface soil samples. Hand augers are advanced manually into the soil and may be used to collect samples to depths of 10 ft or less. The hand auger may be used to collect field screening samples for all analytes, including volatile organic compounds (VOCs), without sample liners. However, for those projects requiring definitive VOC analyses, liners must be used in the hand auger or a slide hammer.

Test pits/trenches are open excavations that can be used to collect subsurface soil samples and geotechnical/engineering information. All test pits/trenches must be constructed in accordance with all state, local, and federal regulations governing excavations including OSHA 29 CFR 1926.650, Sect. P. If possible, samples should be collected without entering the excavation. If it becomes necessary to enter excavations greater than 3.5 feet (ft) in depth, all requirements of the OSHA regulations governing confined space entry must be followed. Extreme caution should always be used when sampling in excavations. For excavations greater than 3.5 ft in depth, a ladder, extending from the base of the excavation to above the ground surface, must always be in place while personnel are in the excavation.

Split-spoon [American Society for Testing and Materials (ASTM) Method D1586] samplers, including the California-modified split-spoon sampler (3-inch-OD, 2-3/8-inch ID),thin-walled samplers (ASTM Method D1587), continuous soil core samplers, and direct-push (e.g., Geoprobe®) samplers are mechanically pushed, driven, or vibrated into undisturbed soil. The samplers collect the soil sample in an enclosed tube, which prevents mixing and contamination of the samples by uphole soils. Soil samples may be collected for geotechnical information and/or chemical analyses. Field screening samples for VOC analyses may be collected directly from the sampler. For those projects requiring definitive VOC analyses, liners should be used.

3.0 REQUIRED EQUIPMENT

3.1 General

The following general equipment is required:

- approved site Work Plan,

- approved site Sampling and Analysis Plan (SAP),
- approved site Health and Safety Plan,
- field logbook,
- camera and film,
- indelible (waterproof) ink pen, blue or black,
- indelible markers,
- sample tags/labels and appropriate forms/documentation,
- appropriate sample containers as specified in the site SAP,
- insulated cooler(s),
- latex inner gloves,
- outer gloves (as needed) of material resistant to suspected contaminants,
- plastic resealable bags and waterproof sealing tape,
- rinse bottles and ASTM Type II deionized water,
- decontamination equipment and supplies (see SOP 011A),
- personal protective equipment (PPE) as required by the site Health and Safety Plan,
- plastic sheeting,
- chain-of-custody forms and security seals,
- appropriate equipment and meters for obtaining field measurements specified in the SAP and the Health and Safety Plan,
- ice for cooling samples, and
- aluminum foil.

3.2 Hand Auguring

The following equipment is needed for hand auguring:

- hand auger (i.e., flighted, bucket, or tube-type augers) and/or slide hammer sampler,
- extension rods as needed,
- wrench(es),
- stainless steel hand trowel or sampling spoon,
- large [minimum 12-inch (in.) diameter] stainless steel, glass, or Pyrex® mixing bowl,
- sufficient sampler liners for collecting definitive VOC samples,

- stainless steel blade to trim excess soil from end of liners (if used),
- Teflon® or silicon tape,
- sufficient end caps to cover both ends of sampler liners (if used), and
- sufficient plastic sheeting to contain all cuttings.

3.3 Test Pits/Trenches

The following equipment is needed for test pits or trenches:

- backhoe or other excavation equipment (as specified in the site Work Plan),
- extension ladder (capable of extending from bottom of excavation to above ground surface),
- trench/pit shoring and bracing equipment (as needed),
- stainless steel hand trowel or sampling spoon,
- large (minimum 12-in.-diameter) stainless steel mixing bowl,
- sampler to be used to collect VOC samples for definitive analyses (as needed),
- sufficient sampler liners for collecting definitive VOC samples (as needed),
- Teflon or silicon tape, and
- sufficient end caps to cover both ends of sampler liners (if used).

3.4 Split-Spoon Sampling (based on ASTM method d1586)

The following equipment is needed for split-spoon sampling (including California-modified):

- drilling rig equipped with a 140-pound (lb) drop hammer and sufficient hollow-stem augers to drill to the depths required by the site Work Plan,
- sufficient numbers and type of split-spoon samplers so that at least one is always decontaminated and available for use; three split-spoon samplers are generally the minimum necessary,
- sufficient numbers and types of sampler liners,
- sufficient plastic sheeting to contain all cuttings and cover the ground surface under the drill rig,
- sufficient waste containers (e.g., 55-gallon (gal) steel drums) as specified in the site Work Plan to containerize all cuttings and IDW,
- Teflon or silicon tape,
- stainless steel blade to trim excess soil from end of liners (if used), and
- sufficient number and types of plastic end caps to cover both ends of all sampler liners (if used).

3.5 Thin-Walled Sampling (based on ASTM method d1587)

The following equipment is needed for thin-walled sampling:

- drilling rig equipped with a 140-lb drop hammer and sufficient hollow-stem augers to drill to the depths required by the site Work Plan;
- sufficient numbers and type of thin-walled samplers so that at least one is always decontaminated and available for use; thin-walled samplers generally are used only once;
- sufficient plastic sheeting to contain all cuttings and cover the ground surface under the drill rig;
- sufficient waste containers (e.g., 55-gal steel drums) as specified in the site Work Plan to containerize all cuttings and IDW;
- sufficient number and types of plastic end caps to cover both ends of all thin-walled samplers;
- Allen wrenches; and
- Teflon® or silicon tape.

3.6 Direct Push Technologies

The following equipment is needed for use with direct push technologies (DPT), such as the Geoprobe™ system:

- DPT truck capable of pushing sampler to depths required by the site Work Plan;
- assembled DPT sampler (standard or large bore as described in the site SAP);
- sufficient extension rods to reach the depths required by the site Work Plan;
- extension rod couplers;
- extension rod handle;
- stop pin;
- sampler liners (as needed) in accordance with the site SAP (e.g., stainless steel, acetate, or brass);
- stainless steel blade to trim excess soil from end of liners (if used);
- Teflon or silicon tape; and
- sufficient plastic end caps to cover both ends of sampler liners (if used).

3.7 Continuous Core Sampler

The following equipment is needed for continuous core sampling:

- drilling rig with continuous coring capability (i.e., hollow-stem auger or rotasonic drill),

- sufficient plastic sheeting to contain all cuttings and cover the ground surface under the drill rig,
- sufficient clear plastic sleeving to hold rotasonic drill cores; sufficient waste containers (e.g., 55-gal steel drums), as specified in the site Work Plan, to containerize all cuttings and IDW,
- drive sleeves (if used to collect samples for off-site laboratory VOC analyses) in accordance with the site SAP,
- stainless steel blade to trim excess soil from end of drive sleeves (if used),
- teflon or silicon tape, and
- sufficient vinyl end caps to cover both ends of the drive sleeves (if used).

4.0 PROCEDURES

4.1 General

The collection of subsurface soil samples is an intrusive event and requires knowledge of the site and careful planning before commencing. Several standard steps should be taken before beginning any subsurface sampling activity.

1. Obtain all site clearances (including utility clearances) and digging permits (SOP 001A).
2. Verify that all logbooks are on the site, up to date, and ready to be used. (See SOP 002A).
3. Photograph the site before commencing work (only with approval of the Sponsor and the facility).
4. Verify (in writing) that all personnel have read and understood the approved site Health and Safety Plan. (All personnel must sign off on the Health and Safety Plan.)
5. Verify that all personnel involved in the sampling activity have the proper training and certifications required under OSHA 29 CFR 1910.120 and 29 CFR 1910.134.
6. Verify the site location by existing maps and surface features. Check for surface features or artifacts (e.g., manhole covers and overhead power lines) that could impede movement on the site or indicate a previously unidentified hazard.
7. Mark off the boundaries of the work site with flagging or other means to prohibit access to unauthorized personnel. All sites should have a single, clearly marked entrance through which all personnel should enter and exit. Sites having a high contamination level or where activities may unearth highly contaminated materials must also have an exclusion zone, contamination reduction zone, and support zone clearly marked and properly maintained. All personnel exiting the work area should pass through a decontamination procedure for their own protection and to prevent the spread of contamination. The extensiveness of the personnel decontamination procedure will be outlined in the approved site Health and Safety Plan.
8. Set up a decontamination line for equipment and personnel. (See SOP 011A.)

9. Check to see that all the necessary equipment (including PPE and samplers) is available at the site, is in good working condition, and has been properly decontaminated.
10. Check that all monitoring equipment is properly calibrated and operating.
11. Set up the IDW management system (e.g., spread plastic, position drums, etc.) as outlined in the site Work Plan. (See SOP 012A.)

At no time should samples, decontaminated sample sleeves, or decontaminated samplers be touched by unprotected (i.e., ungloved) hands. A fresh or decontaminated pair of gloves must be used for each sample collection. Great care should be exercised to ensure that no contaminated tool or device is inserted into the borehole. All down hole tools and samplers must be kept off the ground and/or free from contamination between the time they pass through the decontamination procedure until they are used in the boring.

4.2 Hand Auguring

Hand auguring consists of manually advancing the auger into the soil to collect subsurface soil samples, generally at depths of 10 ft or less. There are several types of hand augers available (e.g., Iwan, ship, closed spiral, and open spiral). All these devices are used in much the same way. The auger is attached to the bottom of a length of steel rods that have a crossbar (handle) at the top. The operator advances the auger by rotating the crossbar while pressing the auger into the ground. As the auger advances, it fills with soil. When the auger is filled with soil, the unit is removed from the hole, cleared, and reinserted. Additional rods are added until the desired depth is reached. Upon reaching the sampling depth, the auger is removed. A decontaminated auger is then used to collect the sample. The same auger may be used in drilling and sampling, but it must pass through the decontamination process between drilling and sampling. When done properly, this method will result in samples for definitive analysis for all analytes except VOCs; however, this method will yield screening data for VOCs. To obtain definitive levels for VOCs, a liner must be used in the auger or in a slide-hammer sampler.

4.2.1 Methodology

The steps for hand-auger sampling are:

1. Complete the standard general steps for subsurface sampling (Section 4.1).
2. Don PPE as required by the site Health and Safety Plan.
3. Using a decontaminated auger, auger to the desired depth.
4. Place drill cuttings on plastic sheeting spread beside boring. Cuttings should be placed in stratigraphic order to show changes as the boring progresses.
5. After reaching the desired sampling depth, remove the auger from the boring and decontaminate. Alternatively, a different auger (decontaminated) may be used to collect the sample.
6. Insert the decontaminated auger into the boring and advance until full. If definitive samples are required for VOC analyses, an auger or slide hammer sampler with a properly positioned sampling sleeve will be used. The type and material of the sleeve will be specified in the SAP.

7. Remove auger from borehole and field screen with the method and equipment specified in the site SAP. Extract sample and place in appropriate containers as specified in the site SAP. If a liner was used, remove liner from auger/slide hammer and place aluminum foil on ends (shiny side away from sample), cap and seal both ends of the liner with Teflon or silicon tape, and place appropriate label on the liner.
8. Place sample container (e.g., liner and jar) in resealable plastic bag and place bag containing sample into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP 010A.)
9. Draw a sketch of the sampling location in the field logbook. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP 002A)
10. Doff contaminated gloves and don fresh or decontaminated gloves.
11. Repeat steps 1 through 10 until sampling is completed.
12. Dispose of cuttings and nonsalvageable equipment as outlined in the site Work Plan.
13. Plug and abandon borehole as specified in the site Work Plan. (See SOP 008I.)
14. Decontaminate all equipment and personnel. (See SOP 011A.)

4.3 Test Pits/Trenches

Test pits/trenches are open excavations that are generally dug by earth moving machinery (e.g., backhoes and bulldozers) that can be used to collect subsurface soil samples and geotechnical/engineering information. All test pits/trenches must be constructed in accordance with state, local, and federal regulations governing excavations. This includes but is not limited to OSHA 29 CFR 1926.650 Sect. P.

Samples should be collected without entering the excavation, if a collapse hazard is present and/or the excavation would be defined as a confined space. A long-handled sampling tool (if available) should be used in pits/trenches greater than 3.5 ft in depth. Should it become necessary for personnel to enter excavations greater than 3.5 ft in depth, all requirements of the regulations governing confined space entry must be followed. Extreme caution should always be used when sampling in excavations. For excavations greater than 3.5 ft in depth, a ladder extending from the base of the excavation to above the ground surface must always be in place while personnel are in the excavation.

4.3.1 Methodology

The steps for test pit/trench sampling are:

1. Complete the standard steps for subsurface sampling in Section 4.1.
2. Don PPE as required by the site Health and Safety Plan.
3. Excavate the pit/trench to the required depth and width. The location and depth of the required samples will be outlined in the SAP. If dewatering of the trench is required, all water should be handled in accordance with the methodology for managing IDW as outlined in the site Work Plan.

4. Place the soil removed from the excavation on plastic sheeting spread in line with, but a minimum of 5 ft back from, the wall of the trench.
5. Using a decontaminated stainless steel spoon or trowel (or other sampling device specified in the site SAP), scoop out a portion of soil from the bottom or walls of the trench (as specified in the site SAP) sufficient to fill the required sampling containers. If definitive samples are required for VOC analyses, a sampling device capable of using liner sleeves must be used. The type and material of the sleeve will be specified in the SAP.
6. Remove the sample from the pit/trench and field screen with the method(s) and equipment specified in the site SAP. Place the sample in the appropriate containers as specified in the site SAP. If a device with a liner sleeve was used, remove liner from sampler, place aluminum foil on ends (shiny side away from sample), cap and seal both ends of the liner with Teflon or silicon tape, and place appropriate label on the liner.
7. Place sample container (e.g., liner and jar) in resealable plastic bag and place bag containing sample into an insulated cooler with ice. Samples should be maintained at 4º± 2º Celsius (C) ±2ºC from the time of collection until received at the laboratory. (See SOP 010A.)
8. Draw a sketch of the pit/trench and indicate the location of the sample in the field logbook. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP 002A.)
9. Doff contaminated gloves and don fresh or decontaminated gloves.
10. Repeat steps 3 through 9 until sampling is completed.
11. Reclaim the pit/trench as outlined in the site Work Plan. At a minimum, soil should be placed in the excavation so that the final permeability is less than or equal to the original condition of the soil.
12. Decontaminate all equipment and personnel. (See 011A.)

4.4 Split-Spoon Sampling

The split-spoon sampler consists of a threaded steel pipe that is split in two pieces along the axis of the pipe. A hardened steel driving shoe is screwed onto the down hole end and a threaded "head" with a check valve is screwed onto the top. The sampler is driven (ASTM Method D1586) into undisturbed soil. The sampler collects the soil sample in the enclosed tube, which prevents mixing and contamination of the sample by up hole soils. Soil samples may be collected for geotechnical information and/or chemical analyses. When done properly, this method will result in samples for screening and definitive data for all analytes except VOCs. Screening samples for VOC analyses may be collected directly from the sampler. To obtain definitive samples for VOCs, liner sleeves must be used in the sampler.

4.4.1 Methodology

The steps for split-spoon sampling are:

1. Complete the standard steps for subsurface sampling in Section 4.1.
2. Don PPE as required by the site Health and Safety Plan.

3. Using decontaminated augers, auger to the desired depth.
4. Place drill cuttings on plastic sheeting spread beside boring or handle as specified in the site Work Plan.
5. Upon reaching the desired sampling depth, attach a decontaminated split spoon to the sampling rods and insert into boring. If definitive analyses are required for VOCs, a split spoon with properly positioned sampling liners will be used. The type and material of the liners will be specified in the SAP.
6. Position the drive hammer on the sampling rods and lightly tap the rods to seat the sampler.
7. Drive the sampler in accordance with ASTM Method D1586 (i.e., a 140-lb hammer is repeatedly dropped 30 in. while counting the number of blows required to drive the sampler each 6-in. interval). Cease driving when the sampler is full, or when 50 blows of the hammer have moved the sampler less than 1 in.
8. Remove the split spoon from the boring. Carefully open the split spoon and immediately field screen the sample with the equipment specified in the site SAP. Extract the sample and place it in appropriate containers, as specified in the site SAP. If liners were used, separate the liners and immediately field screen between each liner. Immediately after field screening, remove the liner designated for VOC analyses from the split spoon. Place aluminum foil, cap, and seal both ends of the liner with Teflon or silicon tape. Place appropriate label on the liner. Proceed to remove, cap, seal, and label the other liners as necessary.
9. Immediately after collection, place sample containers (e.g., liners and jars) in resealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained at 4° ± 2°C from the time of collection until received at the laboratory.
10. Note the sample identification number, depth, time of collection, field screening result, lithologic description, and laboratory analyses requested for the samples in the site sampling logbook. (See SOP 002A.)
11. Doff contaminated gloves and don fresh or decontaminated gloves.
12. Repeat steps 3 through 11 until total required depth is reached.
13. Remove the augers from the boring. Note: When the boring is completed and the augers have been removed, it is sometimes advisable to leave the borehole open for several hours to check for groundwater inflow. This information can be valuable later in the project.
14. Dispose of cuttings and non salvageable equipment as outlined in the site Work Plan.
15. Plug and abandon borehole as specified in the site Work Plan. (See SOP 12.)
16. Decontaminate all equipment and personnel. (See SOP 011A.)

4.5 Thin-Walled Sampling

The thin-walled sampler (also known as a Shelby tube) consists of a one-piece hollow steel tube that is usually 2 to 5 in. in diameter and from 1 to 3 ft in length. The thin-walled sampler is mechanically pushed or driven (ASTM Method D1587) into undisturbed soil. The sampler collects a column of relatively undisturbed soil in the tube. This method generally is used to collect samples for geotechnical information, but it can also be used to collect soil for chemical analyses. When done properly, this method will result in samples for screening and definitive analyses for all analytes. Screening samples for VOC analyses may be collected directly from the sampler in the field. For definitive VOC samples, the entire sampler must be properly sealed and sent to the laboratory.

4.5.1 Methodology

The steps for using the thin wall sampler are:

1. Complete the standard steps for subsurface sampling in Section 4.1.
2. Don PPE as required by the site Health and Safety Plan.
3. Using decontaminated augers, auger to the desired depth.
4. Place drill cuttings on plastic sheeting spread beside the boring or handle as specified in the site Work Plan.
5. After reaching the desired sampling depth, attach a decontaminated thin wall sampler to the sampling head and screw onto the sampling rods. Insert the sampler into the boring.
6. Position the drill head (ram) on the sampling rods and, using the rig hydraulics, push the sampler to the required depth (i.e., fill the tube) or until refusal. A smooth, sustained push will generally yield the best sample. If the rig hydraulics cannot push the tube, it can be driven using the drive hammer. The weight of the hammer, height of drop, and number of blows should be recorded in the field logbook. (See SOP 002A.)
7. Twist the drill rods clockwise to break loose the sample. Withdraw the sampler from the boring.
8. Detach the sampler from the sample rods and remove the tube from the sampling head.
9. For geotechnical analyses and/or definitive VOC analyses, trim off excess soil from either end of the tube until it is at least flush with the rim of the tube. Cap and seal both ends of the tube and mark the "up" end. The sealed tube should be handled carefully to minimize vibration or impacts and should be transported to the laboratory in the upright position. If geotechnical analyses are not desired, the sample may be extruded from the tube on-site, field screened, and placed in appropriate containers. The VOC screening sample must be collected first and as soon after extruding the soil from the container as possible. Proceed to fill the other containers as necessary. Immediately after collection, place sample containers in resealable plastic bags and place bags containing samples into an insulated cooler. Samples should be maintained

at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP 010A.)

10. Note the sample identification number, depth, time of collection, field screening result, lithologic description (if known), and laboratory analyses requested for the samples in the site sampling logbook. (See SOP 002A.)
11. Doff contaminated gloves and don fresh or decontaminated gloves.
12. Repeat steps 3 through 11 until total required depth is reached.
13. Remove the augers from the boring. Note: When the boring is completed and the augers have been removed, it is sometimes advisable to leave the borehole open for several hours to check for groundwater inflow. This information can be valuable later in the project.
14. Dispose of cuttings and non salvageable equipment as outlined in the site Work Plan.
15. Plug and abandon borehole as specified in the site Work Plan. (See SOP 008I.)
16. Decontaminate all equipment and personnel. (See SOP 011A.)

4.6 DPT Subsurface Soil Sampling

Direct Push Technology (DPT) rigs advance a hollow sampling probe, usually with a plastic liner, using hydraulic methods. The Geoprobe unit uses the Probe-Drive sampler to retrieve a soil sample at the working depth of the Geoprobe. Unlike split-spoon samplers, the Probe-Drive sampler remains completely sealed by a piston tip at the end of the sample tube while it is pushed or driven to the desired sampling depth. A piston stop-pin at the opposite end of the sampler is removed by means of extension rods inserted down the inside diameter of the probe rods after the sampler has been driven to depth. This enables the piston to retract into the sample tube while the sample is taken. The large-bore sampler permits the use of internal liners during sampling. The small size of Geoprobe rigs allows access to locations that would preclude using larger rigs.

4.6.1 Methodology

The steps for DPT (Geoprobe) sampling are:

1. Complete the standard steps for subsurface sampling (Section 4.1.)
2. Don PPE as required by the site Health and Safety Plan.
3. Attach a decontaminated sampler to the lead probe rod. For definitive samples for VOC analyses, the large-bore sampler must be used (the large-bore sampler allows the use of liner sleeves). A 12-in. probe rod is recommended to start the standard 24-in. and large-bore samplers.
4. Drive/push the sampler to the desired depth. Some soil conditions may warrant using a retractable or solid drive point to pre-probe the hole to the desired depth. Note: Do not attempt to drive the sampler into bedrock or other impenetrable layer.
5. After reaching the desired sampling depth, remove the drive cap and lower extension rods into the inside diameter of the probe rods using couplers to join the rods.

6. Disengage the stop-pin from the drive head with the extension rods.
7. Remove the extension rods and attached stop-pin from the probe rods.
8. If the top of the probe rod is already in the lowest driving position, attach another probe rod before driving. Replace the drive cap onto the top probe rod.
9. Mark the top probe rod with a marker or tape at the appropriate distance above the ground surface (allow 24 in. for the large-bore sampler). Drive the probe rods and sampler the designated distance. Be careful not to over-drive the sampler, which would compact the soil sample in the tube and make sample extrusion difficult.
10. Extract the probe rods from the hole and recover the sampler. Examine the sampler to confirm that a sample has been recovered.
11. When using the standard sampler, extrude the soil from the sampler, field screen as specified in the site SAP, and place in appropriate, labeled containers. This method yields both screening and definitive samples for all analytes except VOCs. This method yields screening samples for VOCs. When using the large-bore sampler, remove the cutting shoe and withdraw the sample sleeves. Immediately field screen the sleeves as specified in the site SAP. Place aluminum foil on ends of sample, cap and seal both ends of the sleeves with Teflon or silicon tape (the sleeve for VOC analyses first) and label appropriately. This method yields screening and definitive samples for all analytes.
12. Place sample containers (e.g., liners and jars) in resealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP 010A.)
13. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP 002A.)
14. Doff contaminated gloves and don fresh or decontaminated gloves.
15. Repeat steps 1 through 14 until sampling is completed.
16. Plug and abandon borehole as specified in the site Work Plan. (See SOP 008I.)
17. Dispose of non-salvageable equipment as outlined in the site Work Plan.
18. Decontaminate all equipment and personnel. (See SOP 011A.)

4.7 Continuous Core Sampler

The continuous core sampler is a steel tube that may be split in half and held together by threaded collars or may be in one piece. The sampler is usually 5 or 10 ft in length with a 3- to 5-in. diameter. The device may be driven ahead of hollow-stem augers or advanced into the soil by vibrational and/or rotary action.

4.7.1 Methodology

The steps for continuous core sampling are:

1. Complete the standard steps for subsurface sampling in Section 4.1.

2. Don PPE as required by the site Health and Safety Plan.
3. Using the approved drilling method and a decontaminated continuous core sampler, advance to the desired depth.
4. After reaching the desired sampling depth, remove the sampler from the boring and extrude the sample into a holding tray. It may also be desirable to extrude the sample into a clear, resealable plastic bag as it is being placed in the holding tray.
5. Select the desired sampling point on the core. Lightly scrape the core with a decontaminated stainless steel scoop or spoon to remove surface soil and place samples into the appropriate containers. This method yields screening and definitive samples for all analytes except VOCs. This method yields screening samples for VOCs. If definitive samples are required for VOC analyses, a 2-in.-diameter, 4-in.-long stainless-steel or brass sleeves should be driven into the core at the desired sampling point. The length of the sampling sleeve should be equal to or smaller than the diameter of the core to ensure that no headspace exists in the VOC sample. The sleeve can then be extracted and immediately capped and sealed.
6. Place sample containers (e.g., liners and jars) in resealable plastic bags and place bags containing samples into an insulated cooler with ice. Samples should be maintained at 4º± 2ºC from the time of collection until received at the laboratory. (See SOP 010A.)
7. Note the sample identification number, depth, time of collection, field screening result, and laboratory analysis requested for the sample in the site sampling logbook. (See SOP 002A.)
8. Doff contaminated gloves and don fresh or decontaminated gloves.
9. Repeat steps 3 through 8 until sampling is completed.
10. Plug and abandon borehole as specified in the site Work Plan. (See SOP 008I.)
11. Dispose of cuttings and non-salvageable equipment as outlined in the site Work Plan.
12. Decontaminate all equipment and personnel. (See SOP 011A.)

4.8 Collection and Homogenization of Composite Samples

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples used to make up a composite sample are of equal volume and are collected in an identical fashion. There are two basic types of composite soil samples: aerial and vertical. Arial composites are collected from individual grab samples from the same horizontal strata or depth; vertical composites are collected from individual grab samples from within a single vertical profile (i.e., one borehole).

It is important that a composite sample be truly representative if the various sample locations or intervals making up the composite. Therefore, proper homogenization techniques should be followed to generate a composite sample. In addition, the equipment used to composite the sample must not affect the sample quality. A stainless steel bowl and stainless steel or Teflon® or PFTE spoon, properly decontaminated (SOP 011A), are typically used for field compositing of soil samples.

The following steps must be followed when compositing soil samples.

1. Determine where composite sample(s) will be obtained as indicated in the site-specific SAP or comparable plan document.
2. VOC and, in some cases, SVOC samples must be collected and contained immediately as discrete samples and, therefore, cannot be composited.
3. Obtain samples by the methods outlined in this SOP.
4. For split-spoon or Shelby-tube or other cores methods from a specified depth or range of depths, extract or extrude the sample from the split spoon or Shelby tube onto a stainless steel tray or bowl.
5. For hand-auger samples: The sample is acquired directly from the withdrawn auger by using a clean stainless steel or PFTE spatula or spoon. Extract or extrude the sample from the hand auger onto a clean stainless steel tray or bowl.
6. Divide the soil in the sample tray or bowl into quarters. Each quarter is mixed, then all quarters are mixed into the center of the pan. Follow this procedure several times until the sample is adequately mixed. If a round bowl is used, stir the material in a circular fashion and occasionally turn the material over. The extent of mixing will depend on the nature of the material and should be done to achieve a consistent physical appearance prior to filling sample containers.
7. Once mixing is completed, divide the sample material in half and fill containers by scooping sample material alternately from each half. Transfer sub samples of the composited sample into the appropriate sample containers. Seal, wipe clean, and label sample containers. Use the same care in handling these samples as that used for other samples from the site.

5.0 RESTRICTIONS/LIMITATIONS

The restrictions and limitations for hand auguring are:

- The strength of the operator and the quality of the samples required generally limit the use of hand augers to a depth of less than 10 ft.
- Dense, tightly compacted soils or soils with high clay content and/or abundant cobbles will significantly increase the difficulty of hand auguring. Loose dry, sandy, uncompacted soils will be easier to auger through but are more likely to slough into the hole and may not be retained in the auger.
- Hand-augured samples should only be collected above (or slightly below) the water table to avoid mixed samples and to reduce the likelihood of borehole collapse.

The restrictions and limitations of test pits are:

- The depths that can be economically reached by test pits/trenches are limited. For sample depths greater than 15 ft, soil borings are recommended over trenches.

- Large volumes of potentially contaminated material must be handled in excavating and reclaiming the test pit/trench. All fluids removed from the excavation must be assumed to be contaminated and must be tested before disposal.
- There is always the possibility of catastrophic failure of a wall and the collapse of the trench.

The restrictions and limitations for split-spoon sampling are:

- Loose, dry, uncompacted, and/or highly saturated materials may not be retained in the sampler. This condition may require the use of a basket (sand catcher) or spring retainer in the cutting shoe of the sampler.
- Soils with a high cobble or rock fragment content may clog the sampler and prevent adequate collection of sample or layers of well-lithified rock will cause refusal of sampler.

The restrictions and limitations for thin-walled sampling are:

- Loose, dry, uncompacted, and/or highly saturated materials may not be retained in the sampler.
- Soils with a high cobble or rock fragment content may clog or damage the sampler and prevent adequate sample collection or layers of lithified rock will cause refusal of sampler.
- It can be difficult or impossible to properly extrude soils from the sampler on-site. When samples are needed for chemical analyses, another sampling device should be used.

The restrictions and limitations for DPT (Geoprobe) sampling are:

- The standard Geoprobe soil sampler can collect only 100 grams of soil.
- The Geoprobe system is limited to sampling depths of approximately 50 ft in unconsolidated, sandy soils, and to shallower depths in compacted gravelly soils and tills.
- If larger sample volumes are required, two (or more) holes may have to be drilled and sampled.

The restrictions and limitations for using the continuous core sampler are:

- Loose dry, uncompacted and/or highly saturated materials may not be retained in the sampler or may break apart when extruded from the sampler, thus inhibiting proper sampling procedures.
- Soils with a high cobble or rock fragment content may clog the sampler and prevent adequate collection of sample.
- Dense and/or highly compacted soils may be difficult to extrude from the sampler. A split-spoon sampler with sleeves is a better choice if highly compact soils may be encountered and VOC samples are needed.

6.0 REFERENCES

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STANDARD OPERATING PRACTICE TN008F

Monitoring Well Sampling

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STANDARD OPERATING PRACTICE 008F

Monitoring Well Sampling

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) addresses the supplies, equipment, and procedures to be used to purge wells and collect groundwater samples for chemical and natural attenuation parameters. A consistently implemented groundwater sampling procedure will help ensure data comparability between different sampling events. However, in all cases, the methods, equipment, and procedures in this SOP should be tailored to site-specific conditions and project data quality objectives.

The procedures in this SOP apply to permanently installed monitoring wells but may be followed for sampling of temporary wells, extraction wells, and other types of wells with some modifications. This SOP addresses procedures for collection of aqueous samples only. Procedures for collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples or collection of aqueous samples when LNAPL or DNAPL are present in a well are not covered.

7.0 OBJECTIVE

The objective of groundwater sampling is to produce verifiable and legally defensible groundwater quality data. To ensure that this objective is achieved, sampling protocols must be strictly followed and sample collection and handling must be properly documented in field logbooks, groundwater sampling logs, chain-of-custody forms, and project files.

It is common practice to purge monitoring wells before collecting samples. Purging is performed to remove stagnant water from the well and assure that the sample is representative of in-situ groundwater conditions. However, purging techniques can reduce the representativeness of groundwater by affecting well hydraulics and causing chemical changes in the well and aquifer. Therefore, this SOP provides general guidance on sampling techniques, but the user is expected to perform the necessary pre-sampling planning and equipment selection, and to implements methods that area appropriate for each site.

8.0 SAMPLING PREPARATIONS

8.1 Document & Information Review

Prior to obtaining equipment and supplies, review the site-specific plans and historical information. Field personnel or at least the Field Team Leader(s) should review:

- Safety and Health Plan (SSHP), Material Safety Data Sheets (MSDS), and other safety related information. Consider what personal protective equipment (PPE) is necessary and what decontamination procedures must be followed.
- Sampling objectives and procedures specified in the Sampling and Analysis Plan (SAP) (or equivalent work plan document) and Quality Assurance Project Plan (QAPP) (if available).
- Historical sampling data (if available) and well information (location, depth, recharge rates, etc.). Determine the order of well sampling so that the least contaminated wells at the site will be sampled first, progressing to the most contaminated wells last.

- Monitoring well construction logs and available water level data for all wells to be sampled to evaluate the conditions that will be encountered and the approximate volume of water to be purged.
- Chemical analytical sample container requirements, preservatives, holding times, etc. so that you are prepared for collection, preservation, and shipping of samples. Consider where to collect Quality Control (QC) samples such as duplicates, matrix spike (MS), and matrix spike duplicate (MSD) samples.
- Department of Transportation (DOT) hazardous material sampling requirements that may apply to chemical reagents, calibration supplies, and/or samples that contain reportable quantities of hazardous substances.

8.2 Order Equipment & Supplies

Use the attached equipment and supplies checklist (or a project-specific checklist) as a guide when preparing for a groundwater-sampling event. At least 10 days before the sampling event, prepare purchase requisitions and place orders for:

- All necessary sampling equipment and expendable supplies.
- Decontamination supplies; spill response supplies (if necessary)
- Appropriate purge and decon water containment vessels (plastic or steel drums, poly tanks, etc.).
- Sample bottles from the laboratory including sufficient bottles for blanks, duplicates, MS/MSD, and extras to cover breakage.
- Deionized (DI) water for equipment blanks from the laboratory or an appropriate vendor. Check the SAP or QAPP for the grade of DI water that is required for the project; typically TN&A's clients require ASTM II grade DI water.

8.3 Pre-Sampling Field Activities

8.3.1 Check Equipment & Supplies

Prior to beginning sampling, inspect and check all equipment and supplies.

- Check sample bottles to ensure that all necessary bottles, preservatives, and blanks have been provided.
- Inspect all sampling equipment to confirm it is functional and in good repair. If renting equipment, have supplier's contact information handy. Document any equipment repair/maintenance in the field logbook.
- Check expendable field supplies to make sure there are adequate quantities for the entire event.
- Check all chemical reagents required for performed decontamination, sample collection, and sample preservation. Make sure calibration fluids required for field instruments are fresh (not beyond the label expiration date).

8.3.2 Well Gauging and Inspection

Inspect all wells to be gauged and/or sampled to determine the condition of the surface casings, surface seals, well identification, and condition of the casing. The general condition of the wells and any conditions that could affect water level data or sample integrity must be noted in the field logbook and/or sampling forms. If the observed well conditions indicate that data obtained from the well could be comprised, the Field Team Leader will determine if the well should be sampled. Notify the TN&A Project Manager so that the well can be repaired or abandoned.

Measure water levels following the procedures in TN&A SOP 008E. Usually, all wells are measured at the site on the first day so that any influence of purging and sampling the wells is avoided.

If unanticipated LNAPL is encountered in a well, the Field Team Leader will determine if the sampling plan should be revised.

Measure the total depth of each well in accordance with procedures defined in SOP No. 008E unless otherwise specified in a site-specific sampling plan. The measurement will be used in the calculation of the volume of water standing in the well casing. Additionally, comparison of the measured depth to bottom and the well construction log may indicate the presence of sediment on the bottom of the well.

8.3.3 Individual Wellhead Preparations

Prior to working at a particular well, lay plastic sheeting over the well casing and on the ground surface immediately surrounding the monitoring well.

Immediately after opening the cap of the well, check for the presence of volatile organic compounds (VOCs) at the wellhead with an organic vapor analyzer (photo ionization detector or similar). Follow SSHP procedures for on-going monitoring in the breathing zone during sampling.

8.3.4 Estimate Well Volume

Low-flow sampling procedures rely on water quality parameter stabilization to determine when to collect sample (see Section 4.0). However, other sampling methods may require removal of specific well volumes, in which case you need to calculate the purge volume.

To determine the volume of water in a well, considering both water in the well and water in the saturated sand pack, the following formula may be used:

$V = V1 + V2$

Where $V1 = [h1\,(r1)^2\,\pi] \times 7.48$

V1 is the well casing volume in gallons
h1 is the height of the water column in the well in feet
r1 is the inner radius of the well in feet
π (pi) approximately 3.14
7.48 converts cubic feet to gallons

and $V_2 = \{[h_2\,(r_2)^2\,\pi]/0.30\} \times 7.48$

V2 is the well casing volume in gallons
h2 is the height of the saturated filter pack in feet
r2 is the radius of the borehole minus the radius of the well in feet
π (pi) approximately 3.14
0.30 is the estimated porosity of the filter pack
7.48 converts cubic feet to gallons

9.0 LOW-FLOW GROUNDWATER SAMPLING PROCEDURES

9.1 Method Summary

Whenever possible, low-flow purging and sampling procedures should be followed for collection of groundwater samples. The purpose of low-flow sampling is to collect groundwater quality data that is representative of groundwater conditions in the geologic formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that minimizes drawdown. The low-flow target pumping rate is generally 100 to 500 milliliters per minute (ml/ min) or a rate that is sustainable given the well-specific yield and results in a total head loss in the well of 0.3 feet or less.

9.1.1 Limitations

The low-flow purge and sampling techniques described in this section are not appropriate at all wells. Low-yield wells may not be suitable for low-flow sampling, as the minimally sustainable pumping rate may still generate significant drawdown or completely dewater the well. Wells suited for low-flow procedures are those with that are screened below the water table in moderate to highly permeable material.

9.1.2 Low-Flow Sampling Objectives

The objectives of low-flow sampling include:

- Minimizing drawdown in the well during purging so that geochemical changes caused by filter pack and aquifer aeration are avoided. Minimized drawdown also prevents mixing of stagnant well casing water (water above the screened interval) with aquifer water.
- Maintaining the lowest sustainable pumping rate during pre-sample purging and sampling,
- Avoiding the need to filter samples for metals analyses by minimizing sample turbidity,
- Minimizing purge water volumes by relying on water quality parameter stabilization to determine when to collect the sample, and
- Obtaining reliable water quality parameters by measurements taken within a completely filled (air free) in-line flow-through cell.

Samples are collected when field-measured water quality parameters have stabilized indicating the presence of formation water. Therefore, low-flow purging generally does not include an objective for removal of a specified number of well volumes. Hence, low-flow sampling techniques tend to minimize the volume of purge water that needs to be properly managed and disposed.

9.1.3 Equipment

Generally, a submersible pump (bladder pump, Grundfos, Fultz, or other) is used with the pump intake set within the saturated well-screen interval at least 2 feet off the bottom of the well. A peristaltic pump with appropriate controller may be used for low-flow sampling in wells less than 25 feet deep. However, specific sample collection methods for VOC samples must be followed as peristaltic pumping might induce loss of VOCs due to pressure changes at the pump head (See Section 4.3).

Pump discharge tubing is connected to an in-line flow-through cell equipped with water quality probes (temperature, pH, dissolved oxygen, etc.). Sample volume is collected after water quality parameters have stabilized. Disconnect the intake tubing from the flow-through cell; do not collect samples from the discharge line after the flow-through cell.

Low-flow sampling techniques for different pumps are described in Sections 4.2 and 4.3. Water quality parameter stabilization criteria are described in Section 4.4.

9.2 Submersible Pumps

9.2.1 Pump Selection

Submersible pumps are suitable for wells that have yields greater than 0.3 gpm and a total purge volume of greater than 5 gallons. Basic types of submersible pumps that are suitable for low-flow sampling include bladder pumps and positive displacement pumps. Common brand names include QED Micropurge™ (bladder), Grundfos Redi-Flo 2 (positive displacement), Fultz (progressive cavity), and Keck (progressive cavity) pumps. Other pumps are available. Pre-field planning should include careful consideration of pump parameters, well-field conditions and data quality objectives. Selection of a pump that is not suited to site conditions can affect sample quality and result in unnecessary time delays and costs.

9.2.2 Grundfos Redi-Flo 2 Procedure

This section describes the procedure for use of the Grundfos Redi-Flo 2 submersible pump. Equipment requirements include properly sized tubing, a generator (minimum 3500 watt), pump and controller. An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the pump discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

The Grundfos Redi-Flo 2 is most suitable for moderate- to high-yield wells where water quality parameters stabilize quickly. However, it should be noted that this pump generates heat at low-flow rates, which degrades sample quality. This factor should be considered during pump selection.

To setup for use, connect the safety cable and appropriate length of Teflon-lined tubing to the discharge port of the Grundfos pump. Roll out pump and cable and mark desired pump depth (minimum 2 feet above bottom of well) on the cable with a wire-tie or sampling tape. Measure appropriate length of tubing, providing sufficient tubing for setup of flow-through cell. Cut tubing and attach to pump. Use nylon wire-ties to bind safety cable, power line, and discharge tubing together to prevent tangling of lines downhole.

Review the performance history of the well to estimate the purge rate and pumping conditions that can be expected. Insert the pump into the well. Maintain a slight tension on the controller wire and the safety cable. Slowly lower the pump and complete surface setup.

With the pump in place at least 2 feet off the bottom of the well, measure depth to water with a level indicator and compare the water level to the static reading (allow well to return to static water level before beginning pumping for accurate drawdown measurement). Make the proper connection, hook up the pump discharge tubing to the flow-through cell, and place the flow-through cell discharge tubing into the purge drum. Start the generator, plug in the controller, and check all tubing and instruments to ensure proper connection. Begin purging the well by slowly increasing the frequency knob on the controller. Monitor the pump discharge rate by using a graduated container. Follow the purging and sampling procedures described in Sections 4.2 and 4.3.

For wells less than 100 feet in depth, the frequency is generally less than 200 hertz (Hz). For wells greater than 200 feet in depth, the frequency may be adjusted up to 320 Hz. As a general rule, the discharge rate is proportional to the controller setting. This is not the case if the well is slow to recharge.

9.2.3 Fultz Pumps

This section describes the procedure for use of a Fultz submersible pump. A Fultz pump uses a positive displacement pump head constructed of stainless steel and Teflon. Water is introduced into the pump through a 60-mesh screen into the stainless steel pump cavity. Once in the pump cavity, two Teflon rotors transfer the water up the tubing. The Fultz pump comes equipped with a hose barb and typically uses ½-inch polyethylene or Teflon-lined polyethylene tubing. Typically, the tubing is used once and discarded after each sampling point. Equipment requirements include properly sized tubing, pump, controller, hose, hose reel (optional, but recommended for deep wells), and a power inverter so that pump can be powered from car/truck 12-volt battery. An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

Follow the Grundfos pump set-up procedure described in Section 4.2.1 except the pump power cable will be attached through a power inverter to a 12-volt battery (plug into vehicle's cigarette lighter).

9.2.4 Bladder Pumps

A bladder pump operates using compressed air to pressurize the pump chamber, which squeezes an internal bladder filled with groundwater. The cyclical pumping action creates a pulsing flow of water out the pump discharge tube. The pressurized air does not come into contact with the water. This pumping method is considered to be among the best for VOC sampling. Equipment requirements include properly sized tubing, pump, controller, and compressed air supply (compressed air tanks or oil-less air compressor). An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the discharge line. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate.

Generally, bladder pumps are difficult to decontaminate and are typically installed as well-dedicated pumps for on-going monitoring programs (such as at landfills). However, portable bladder pumps with removable disposable bladders are available.

Follow the Grundfos set-up procedure described in Section 4.2.1 except the pump is powered with compressed air from a tank or from an oil-less air compressor.

9.2.5 Low-Flow Purging with a Submersible Pump

For standard low-flow well purging, the following procedures shall be performed at each well:

- Don personal protective equipment (PPE) as specified in the Health and Safety Plan (HSP).
- The condition of the outer well casing, concrete well pad, protective posts (if present), and any unusual conditions of the area around the well shall be noted in the field logbook. The well may also be photographed. Any deficiencies in well integrity shall be reported immediately to the Project Manager.
- Upon opening the well, check the atmosphere in the well and the area around the well for volatile organic chemicals (VOCs) using a photoionization detector (PID) or flame ionization detector (FID). Record this reading on the field data form or in field logbook (background reading). If measured levels of VOC vapors and/or methane exceed action levels as given in the HSP, take appropriate actions.
- If necessary during purging/sampling, monitor VOCs in the breathing zone. If measured levels of VOC vapors exceed action levels as given in the HSP, take appropriate actions.
- The depth-to-static water level shall be measured with a water level indicator to the nearest 0.01-foot and recorded from the measuring point on the well casing, and recorded. Calculate the volume of water in the well (per Section 3.3.4) and record on purge/sample log.
- Assemble the pump and sampling line components taking care not to contact any of the components with potentially contaminated media, and ensure that the discharge line is affixed so that the initial discharge is captured in either a graduated 5-gallon bucket or a purge water collection/disposal drum.
- Slowly lower the pump into the well casing to a point in the middle of the screened interval (generally at least 2 feet above the bottom of the well). Avoid tagging the bottom of the well. Maintain the pump at the desired depth level by tying the supporting cable off in some manner. Measure depth to water after deployment of the pump; allow the well to recover to static water levels before pumping. Keep the water level indicator in the well to monitor water levels during purging.
- Set up the flow-through cell with multiparameter probe and connect to the pump discharge line. Attach the flow-through cell discharge line to a bucket to capture purged water.
- Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water levels frequently. Adjust the pump until there is less than 0.3 to 0.5 feet of drawdown. If the minimal drawdown that can be achieved exceeds 0.5 feet but remains stable, continue purging until indicator field parameters stabilize. Pumping rates should be adjusted to the minimum rater required to maintain a steady flow of water through the flow-through cell, to keep the flow-through cell fully saturated, and to prevent formation of air bubbles in the pump discharge line.
- Using a stopwatch and a graduated cylinder or container, periodically measure the pumping rate. Monitor the water level, pumping rate, cumulative withdrawal, and field parameters every 3 to 5 minutes. Record the pumping rate and field indicator parameters.

When the indicator field parameters (pH, temperature, specific conductance, dissolved oxygen, and turbidity) are stabilized, purging is complete and samples may be collected. See Section 4.4 for discussion of issues related to stability of field parameters and decision-making.

If drawdown in the well during low-flow purging does not stabilize and/or is greater than 0.3 feet (from static) using the lowest-possible flow rate of the pump, then this procedure may not be feasible for that well. The sampling team should inform the Field Team Leader and/or Project Manager if this is the case. An alternative procedure for purging the well may need to be approved by the Client Representative and the change in procedure noted as a variance to the work plan (see project specific SAP or QAPP).

Avoid aerating a previously submerged well screen, as this can lead to chemical changes in the groundwater. If it appears that low-flow purging will draw the water column down below the top of the screened interval, the sampling team may need to adjust the purging procedure to allow recovery between purging events. In this case, leave the pump in position and continue to monitor depth to water. Use professional judgment to balance time length of purging, stability of water quality parameters, and the need to collect a sample.

Manage purge water in accordance with the project QAPP and Work Plan. Take necessary precautions to prevent spilling potentially contaminated water.

9.2.6 Low-Flow Sampling with a Submersible Pump

The following sampling procedures shall be used at each well where low-flow sampling procedures are applicable:

- When field parameters are stabilized (Section 4.4) and turbidity is at or below the required limit, begin to collect the groundwater samples. The pump should not be moved or adjusted between purging and sampling.
- Measure and record field parameters in the flow-through cell one final time, including pH, temperature, specific conductance, oxidation/reduction potential (ORP), and dissolved oxygen. Also measure turbidity.
- Disconnect the flow-through cell and collect the samples from the pump discharge tube. Collect VOC samples first. If necessary, attach a disposal filter and follow the field-filtering procedure discussed in Section 6.0 of this SOP.
- The ideal sampling flow rate is 100 ml/min, but should be as low as possible for collection of VOC samples. Record the sampling flow rate on the purge/sample log.
- Completely fill VOC sample vials so the water forms a convex meniscus at the top, then capped so that no air space (i.e., bubbles) are present in the vial. Turn the vial over and tap it smartly to check for bubbles that indicate air space. If bubbles are observed, open the vial, fill the septum cap with additional sample and slowly pour into the vial to form a convex meniscus again at the top and attempt to recap the vial. If repeated attempts are unsuccessful at eliminating air space, discard the vial and collect another sample vial. If sample is spilled during this procedure, discard the vial and collect another sample vial.
- Completely fill the containers for all other analyses.

After the samples have been collected, they should immediately be placed in an ice-filled cooler. The sampling team will keep the coolers in their possession until relinquished to the on-site laboratory or to the Sample Coordinator, or until shipped to an off-site fixed-base laboratory.

9.2.7 Sample Collection Order

When using a submersible pump, samples are usually collected in the following order (as applicable):

1. VOCs
2. Diesel range organics (DRO) and gasoline range organics (GRO)
3. SVOCs, total petroleum hydrocarbons (TPH)

4. PCBs and Pesticides
5. Metals
6. Other organics
7. Other inorganics

Refer to the project-specific QAPP and task-specific work plan for sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the manufacturer's instructions included with the test kits to conduct the field analyses. The field test results will be recorded in the field logbook and purge/sample log.

9.3 Peristaltic Pump Procedures

A peristaltic pump may be used for low-flow sampling for wells that are 25 feet or less in depth. Peristaltic pumps offer distinct advantages over submersible pumps for wells with obstructions or slow recharge rates. However, peristaltic pumps cause a pressure change in the sample at the pump head, which is believed to result in sample degassing. To avoid this problem, use the procedures in Section 4.3.3 for VOC sampling.

9.3.1 Equipment

The peristaltic pump should include a forward and reverse switch and a speed controller. Intake tubing (before pumping mechanism) and discharge tubing (from pumping mechanism) should be ½-inch diameter Teflon or Teflon-lined polyethylene tubing; however, pliable silicon tubing (such as Tygon™) is required for the pump head to function properly. A Barnant™ peristaltic pump can accept various tubing diameters and offers a lever mechanism for the pump head, making installation of the tubing easy. A Geopump™ peristaltic pump (or equivalent) is also acceptable. An in-line flow-through cell and multi-parameter probe (YSI 3500 or equivalent) is attached to the discharge line after the rotor heads. Discharge tubing from the in-line flow-through cell should be positioned over a bucket or drum to capture purge water. A graduated liter beaker and stopwatch will be used to measure the flow rate. The pump is powered by a connecting the power cables to an inverter plugged into the car/truck cigarette lighter.

9.3.2 Low-Flow Purging with Peristaltic Pumps

Attach intake tubing to Tygon (or equivalent) tubing that goes through pump mechanism. Carefully insert the intake tubing down into the well to minimize disturbance of the water column. Lower the intake tubing end to the middle of the saturated screened interval. Avoid tagging the bottom of the well and keep the tubing end at least 2 feet off the bottom of the well. Attach discharge tubing to Tygon tubing and attach in-line flow-through cell, then additional discharge tubing. Position flow-through cell discharge tubing in bucket or drum to contain purge water.

Connect power and turn the pump on (forward direction) at a low pumping rate setting. While measuring water levels in the well, adjust the pumping speed until the lowest sustainable rate with minimal steady-state drawdown is attained. The pumping rate should induce no more than

0.3 to 0.5 foot of drawdown. If excessive drawdown is noted using a flow rate of 100 ml/min or less, then low-flow sampling procedures may not feasible at this well. Refer to procedures for slow-recharging wells in Section 4.3.4.

Continue purging until water quality parameters have stabilized, as discussed in Section 4.4. After field parameters have stabilized, collect the sample as described in Section 4.3.3, below.

9.3.3 Sampling with Peristaltic Pump

Once parameters have stabilized, disconnect the flow-through cell and collect groundwater samples into the appropriate containers.

Turn off the pump. Disconnect the flow-through cell from the pump discharge tubing and place sample container at tubing end. Turn on the pump and fill sample containers. See Section 4.3.5 for sample collection order. ***Note that VOCs samples are collected last because the tubing must be pulled from the well***.

For VOC samples, use the following procedures:

- With the intake tubing completely filled with groundwater, turn the pump off.
- Carefully pull the intake tubing out of the well and position the tubing end over the VOA sample vials.
- Reverse the pump flow direction at a very low flow rate and pump water out of tubing into VOAs.
- Alternatively, after the pump is turned off, disconnect the intake tubing from the Tygon tubing, stopper at the end with a clean, gloved hand, and pull from the well. Position the end of the tube over the VOAs and drain the water into the VOAs.
- Because this procedure involves removing the tubing from the well, collect VOC samples last in the sampling order.

When metals analysis is required, use an in-line; a disposable 0.45 µm filter is used to filter the groundwater directly from the pump discharge tubing. See Section 6.0 for field filtering procedures. Note that, if turbidity in the sample is very low (10 NTUs or less), the groundwater sample is considered to be representative of dissolved metals and does not need to be filtered prior to preservation. The task-specific work plan and QAPP should specify the turbidity target for unfiltered dissolved metals samples.

9.3.4 Peristaltic Pump Procedures for Slow Recharge Wells

In slow-recharge wells with water column in the well casing (above screened interval), pump out the well casing water so that the water level remains above the top of the screen. Raise the tubing intake to no less than 6 inches above the well screen top and pump until casing water column is removed. Do not pump the water below the screen level to avoid aeration of the screen. Allow the well to recover to at least 80 percent of static level. Repeat this procedure at least twice to ensure influx of aquifer water into the screened interval.

For sampling, lower the tubing intake to mid-screen depth (2 feet above well bottom) and pump using as low a flow rate as possible. Collect VOC samples last, following the procedure described in Section 4.3.3. Monitor water levels to prevent drawdown into the screen, if possible. Maintain a pumping rate that prevents air bubble formation in the intake tubing.

For water table wells (water level within screened interval) with slow recharge rates, it is unlikely that excessive drawdown can be avoided. Pump down the well using a slow pumping rate removing most of the water column. Avoid complete dewatering as this may result in agitation of the sediments in the bottom of the well. Using a slow pump rate may help minimize cascading of water into the well. Allow the well to recharge completely. Repeat this procedure at least twice, or if possible, until water quality parameters have stabilized. Measure water quality parameters (except turbidity) down-hole, following the procedures described in Section 4.4.

For sampling, place the tubing intake at least 2 feet off the well bottom and pump water at a slow steady rate while monitoring drawdown in the well. It may be necessary to increase pump speed to prevent air bubbles in the tube.

9.3.5 Sample Collection Order Using A Peristaltic Pump

When using a peristaltic pump, samples are usually collected in the following order (as applicable):

1. DRO and GRO
2. SVOCs, TPH
3. PCBs and Pesticides
4. Metals
5. Other organics
6. Other inorganics
7. VOCs (see Section 4.3.3)

Refer to the project-specific QAPP and task-specific work plan for sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. Follow the manufacturer's instructions included with the test kits to conduct the field analyses. The field test results will be recorded in the field logbook and/or the groundwater-sampling log.

9.4 Water Quality Parameter Measurement

Water quality parameters to be monitored during the low-flow purge process will include pH, temperature, conductivity, ORP, DO, and turbidity. Measurements will be taken at 5- to 10-minute intervals. A flow-through cell, or flow-through setup, will be used to measure field parameters at the discharge from the purge pump. Grab samples will be collected to measure turbidity. Field parameter stabilization is defined as four consecutive readings within the criteria defined in the site-specific sampling plan. Example stabilization criteria are presented in Table 1.

Table 1. Example Parameter Stabilization Criteria

Measurement	Criteria
pH	± 0.1 pH unit
Temperature	± 10 percent

Specific conductance	± 3 percent
ORP	± 10 millivolts (mV)
Dissolved oxygen	± 10 percent
Turbidity	± 10 percent (with a target of less than 10 NTUs)(1)

(1)Values of less than 10 NTUs are considered to be equivalent.

If, after indicator parameters have not stabilized (or turbidity remains above the desired level) after 1 hour of purging and/or at least three well volumes have been removed from the well, document the efforts to achieve stabilization of field parameters and collect the sample.

Groundwater samples will be collected after field parameters have stabilized. Under low-flow sampling conditions using a submersible or peristaltic pump, no minimum volume of water is required to be removed from a well prior to sampling. However, if field measurements have not stabilized after three well volumes have been removed, then field measurements will be reviewed to determine whether collecting a sample is appropriate.

Professional judgment will be required in certain circumstances. For example, if DO readings are in the 5 to 7 milligrams per liter (mg/L) range, then 10 percent is a reasonable fluctuation. But if DO is in the 0.5 to 1 mg/L range, then fluctuations within 10 percent are perhaps overly stringent. The same is true for conductivity and the 10-mV goal for ORP. If, after three well volumes have been purged, all but one or two parameters have stabilized but are relatively close to their respective target bounds, then this may be an adequate indication that formation water is being removed. If the parameters that are out of compliance show a definite decreasing trend, then additional purging may continue in an effort to attain their respective goals. Rationale for samples collected when field parameters are outside of the target fluctuations will be documented on the sample collection logs.

Turbidity measurements will be treated differently for different situations. Acceptable turbidity levels also vary from well to well and should be specified if possible in the task-specific work plan based on historical trends. Typically, groundwater turbidity at less than 10 NTUs is required for sampling for metals analyses without filtering.

When metals are not an analytical parameter, then turbidity is not as great a concern and the target will be less than 20 NTUs. However, in both cases, these goals may not be attainable due to silty or clayey aquifer matrix. If each parameter has stabilized but turbidity is still above the target NTU value, then purging may continue in an effort to attain the target NTU or to see if a downward trend in turbidity is evident. Decisions to continue purging will be based on how far out of compliance the values are (e.g., 15 versus 100 NTUs), and whether NTU values are constant or show a decreasing trend.

If field parameters have not stabilized after three well volumes and if additional efforts have been unsuccessful in reaching the target stabilization goals, the Client Representative will be notified (if appropriate). Project staff will be consulted to decide the appropriateness of collecting a groundwater sample if a project variance is required.

10.0 PURGING AND SAMPLING PROCEDURE USING A BAILER

The use of bailers to purge and sample wells offers a low-cost, highly portable method of sampling; however this method is believed to provide poor quality samples. Normal practice using bailers is to purge a set number of well volumes, or until the well is dry, and then allow the well to recover for sampling. Sample quality is affected by aeration and agitation of the water column, mixing of water from the well casing with groundwater in the screened interval, generation of turbidity due to the surging action of the bailer, and other problems (Nielsen and Nielsen, 2002). Use of bailers may also expose field personnel to an increased risk of exposure to contaminants and may not be advisable for sampling highly contaminated wells. For these reasons, bailer sampling is now generally considered to be the sampling method of "last resort".

Bailers are constructed of PVC, PFTE, Teflon™, or other plastics and consist of a cylinder with a bottom check valve and a means for attaching twine or rope at the top. The bailer is lowered into the well, allowed to fill with water, and is then removed. Bailers can be ordered in various diameters and lengths. Bailers are difficult to decontaminate and generally only single-use disposable bailers are used for groundwater sampling.

10.1 Bailer Purging Procedure

Typically, when using the bailer method, three well volumes of water are removed and the well allowed to recover before sampling. Water quality parameters such as pH, temperature, etc. are typically measured in the purge water bucket, but these data should <u>not</u> be considered representative of in-situ groundwater quality. More reliable data may be obtained by measuring water quality parameters downhole before or after sampling is completed using a multi-parameter instrument. If measured after sampling, allow the well to recover first.

Spread plastic sheeting over the top of the well casing, cutting an access hole in the plastic at the well opening. The plastic will keep the bailer and twine from touching the ground and protective well casing, possibly cross-contaminating the sample. Measure depth to water and total well depth. Attach the appropriate length of twine to the bailer (use non-tangling type of twine) and loop the other end to your wrist. Gently and slowly lower the bailer into the well and avoiding tagging the bottom to minimize sediment disturbance and water column aeration. Allow the bailer to fill with water and slowly remove. Use a "windmill" motion of the arms to reel up the bailer and keep the line from tangling. A tripod and reel or a mechanical winch (i.e. a Smeal Rig) can be used to raise and lower a bailer if the well is deep.

Discharge purged water into bucket or drum. Record volumes removed on the purge/sample log. After removal of one well volume, measure the well recharge rate by periodically measuring and recording depth to water.

10.1.1 Procedure For Wells with Water Level Above the Screen

If there is significant water column above the screen, avoid drawing the water level down below the top of the screen by bailing out only the water above the screen (casing water). Allow the well to recover to static level or 80 percent of static level and repeat the bail-down of the casing water until three casing volumes have been removed. This procedure avoids aeration of the screened portion of the well, while allowing aquifer water to flow into the well.

> ***Example***: *Total well depth is 25 feet, well screen length is 5 feet (20 to 25 feet), and depth to water is 12 feet. There is 8 feet of water column above the top of the well screen (13 feet total water column minus 5-foot screen). Bail down the 8-foot water column without lowering the bailer into the screened interval, and then allow the well to recover. To keep track of the depth of the bailer, mark the bailer twine with tape at 20 feet (including the length of the bailer).*

If it takes more than 4 hours for a well to recover, you can follow same procedure as above, but reduce the number of bail-down times until a volume equal to one well volume is removed.

10.1.2 Procedure for Water Table Monitoring Wells

In this case, the groundwater level is within the well screen. The primary concerns are to not further aerate the well and avoid/minimize disturbance of well bottom sediments. Follow the same procedures as above, but keep the bailer at least 6 inches to a foot above the well bottom.

Minimize aeration of the water column and the surging effect caused by sudden water displacement by slowly raising and lowering the bailer. After pre-sample purging is completed, wait 15 to 30 minutes to allow some settlement of the fines stirred up by the purging process (studies suggest it can take up to 48 hours for most suspended fines to resettle). Avoid tagging the well bottom with the bailer during sampling.

10.2 Bailer Sampling Procedure

After pre-sample purging is completed, allow the well to recover for the final time while you prepare your bottles for sample collection. Once the well has recovered at least partially (recovery percentage allowed may depend on your sample volume needs), slowly lower the bailer into the water column. The bailer should be lowered so that it is within the screened portion of the well. Slowly remove the bailer to minimize disturbance to the well. Once at the surface, transfer the bailer contents to your sample containers. You can pour off the top of the bailer or drain off the bottom. Pouring the sample can result in loss of volatiles. The preferred method is to insert a bottom-emptying device into the bottom of the bailer. The device is pressed into the hole in the bottom of the bailer, which unseats the bailer check ball. The preferred device has a valve or other mechanism that allows you to start/stop the flow. A second person or a bailer stand makes use of the bottom-emptying device easier by holding the bailer, thus freeing the hands to handle the valve and sample containers.

10.2.1 Sample Collection Order

When using a bailer, samples are usually collected in the following order (as applicable):

8. VOCs
9. DRO and GRO
10. SVOCs, TPH
11. PCBs and Pesticides
12. Metals
13. Other organics
14. Other inorganics

Refer to the project-specific QAPP and SAP for sample containers, preservatives, and holding times.

After the laboratory-supplied sample containers are filled, labeled, and placed in a cooler on ice, field analyses may begin if required. Field analyses of groundwater may be performed for ferrous iron, sulfide, or other parameters using field test kits. The guidelines in TN&A SOP 009 and the manufacturer's instructions included with the test kits outline the procedure that will be used to conduct the field analyses. The information will be recorded in the field logbook.

10.3 Recovering a Lost Bailer

Occasionally, the twine may be lost down the well with the bailer or the bailer may come loose from the twine and be lost down the well. Every effort should be made to recover the bailer since the well may not be usable for sampling otherwise. The easiest way to recover a lost bailer is to use a three-prong fishhook (treble hook) tied to a line to hook the twine or bailer and pull it up. If a hook is not readily available, sometimes a sufficiently long tape measure with a right angle metal tab at the end can be used to hook and pull up the twine.

11.0 FIELD FILTERING OF SAMPLES

Field filtering of groundwater samples may be required for samples to be analyzed for "dissolved metals." Field filtering is appropriate for sample with turbidity of greater than 5 to 10 NTUs (depending on project-specific QAPP), but is unnecessary for samples with equal to or less than 5 NTUs. Groundwater samples should be filtered immediately upon collection and prior to chemical preservation of the sample. Filtration should be completed in as short a time as possible while minimizing sample aeration, agitation, pressure changes, temperature changes, and prolonged contact with ambient air.

The project-specific SAP should specify if and when (for which wells) field filtering will be performed. The SAP should also specify the type of filter that will be used. Typically, 0.45-micron disposable capsule filters are used for groundwater sampling. The samples should be filtered before being preserved. If you are using a bailer for sampling, transfer the sample to a clean container and filter the sample using a peristaltic pump with an in-line filter. Alternatively, there are apparatuses to pressurize a transfer container or the bailer, which forces the sample through a filter. If using a pump to sample the well, attach the filter to the outflow tubing and fill the sample containers from the outflow end of the filter.

Follow manufacturer's instructions for use of the filters. ***Pre-condition*** the filter prior to filtering the sample by pumping a sufficient volume of sample water through the filter to completely saturate it. ***Discard*** the "preconditioning" filtrate (place in purge water container). Collect sample after the filter has been pre-conditioned.

After collection of the filter sample, add the appropriate field preservative. Field preservation information should be included in the project-specific SAP and/or QAPP.

12.0 SAMPLE MANAGEMENT AND CHAIN-OF-CUSTODY PROCEDURES

After each sample is collected, samples will be labeled and handled in accordance with methods specified in the project-specific SAP and QAPP. Guidelines for sample labeling, chain-of-custody procedures, sample packaging, and sample shipping procedures are provided in TN&A

SOP 010C. Note that DOT hazardous material sampling requirements may apply to samples that contain reportable quantities of hazardous substances.

13.0 GROUNDWATER QUALITY CONTROL SAMPLES

All QA/QC sampling activities must comply with the requirements of the project QAPP and SAP. Several types of QC samples can be collected including equipment (rinsate) blanks, field blanks, material blanks, duplicates, matrix spike and matrix spike duplicates, and trip blanks.

Equipment rinsate samples (equipment blanks) are usually collected after sampling a known or suspected contaminated well to assess the effectiveness of decontamination procedures. Equipment blanks are taken in the field by pouring laboratory-grade (ASTM II) DI water through the decontaminated pump or other sampling device, collecting the rinsate into the proper sample containers. The equipment blank is preserved, labeled, and stored exactly the same as a groundwater sample.

Field blanks are collected to assess if ambient sources of contamination, such as fumes from internal combustion engines, may affect groundwater sample quality. Collect a field blank while at a groundwater sampling location in an area where an ambient atmospheric source is present. Pour laboratory-grade DI water into the samples containers (typically VOC vials) and treat exactly the same as a groundwater sample.

Duplicate samples are collected to evaluate the accuracy and precision of the contract laboratory. Duplicate samples are collected at the same time as the associated environmental samples (called field or original samples). All of the sample bottles for a particular analysis for both the duplicate and the environmental samples will be filled before filling the sample bottles for the next analysis. For instance, fill all the VOC bottles prior to filling the SVOC bottles.

Trip blanks are submitted to the laboratory to evaluate the potential for cross-contamination of VOCs within the shipping cooler. Appropriate sample containers filled with analyte-free water will be sealed and provided by the laboratory. Trip blanks accompany sample shipments containing VOC samples (see project SAP for frequency of trip blanks). Keep trip blanks with sample containers during all stages of the sampling effort.

14.0 FIELD EQUIPMENT CLEANING PROCEDURES

Sampling equipment, including electrical water level tapes, flow-through cell, pumps, etc. should be decontaminated upon arrival on-site (unless guaranteed clean by supplier) and between each well. Field decontamination procedures may be specified in the project QAPP. Otherwise, use the decontamination procedures in TN&A SOP 011A.

Generally, sample the least contaminated wells first (if known) as an additional precaution against introducing contaminants into the wells and samples. If decontamination is performed in the field, all rinse water must be contained in a manner that prevents the introduction of contamination to the site environment. See TN&A SOP 012A for IDW management.

15.0 FIELD DOCUMENTATION

Thoroughly document groundwater sampling procedures, equipment, and events to ensure the legal defensibility of the data. Additional field documentation procedures are presented in TN&A SOP 002A.

Maintain field notes in a bound "weather-rite" logbook to provide a daily record of sampling and events. Follow site-specific requirements for completing daily field activities logs, purge logs, and groundwater sampling logs.

16.0 REFERENCES

ASTM, 2002a. Standard Guide to Purging Methods for Wells Used for Ground-Water Quality Investigations, ASTM D 6452-99. American Society for Testing and Materials. West Conshohocken, PA.

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United States Environmental Protection Agency (U.S. EPA). May 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Region 4, Environmental Services Division.

U.S. EPA. November 1992. RCRA Ground-Water Monitoring Draft Technical Guidance, Office of Solid Waste.

U.S. EPA Region I. July 30, 19976. Low Stress (Low Flow) Purging And Sampling Procedure For The Collection Of Groundwater Samples From Monitoring Wells. SOP GW 0001 Low Stress (Low Flow) SOP Revision Number 2, 13 pages.

Groundwater Sampling Checklist

Tools

☐	¾" and 9/16 socket or wrench	☐	Mallet
☐	15/16" socket wrench (for drums)	☐	Wire cutters and/or knife
☐	Screwdriver, Pliers	☐	Crescent wrench

Decontamination/IDW Supplies

☐	Isopropyl and DIW spray bottles	☐	Brushes
☐	DI water (4 x 5 gallon carboys)	☐	Liquinox
☐	30 gallon vessel w/20 gallon potable water	☐	Trash bags
☐	20 gallon carboy with decontamination solution	☐	Plastic wash tubs
☐	30 gallon vessel with 20 gallons soapy water	☐	Fluid containment (drums or poly tanks)

Personal Protective Equipment

☐	Tyvek	☐	Caution tape (if needed)
☐	Hardhat (if required)	☐	Traffic cones (if needed)
☐	Safety glasses, splash guard	☐	Nitrile gloves
☐	Steel-toed boots and booties	☐	Work gloves
☐	Ear plugs	☐	2-way radio
☐	First aid kit	☐	Fire extinguisher

Miscellaneous Supplies

☐	Well keys and caps	☐	Bolt cutters
☐	Extra locks	☐	Extra bolts
☐	Nylon wire ties	☐	Tubing cutter

Sample Equipment / Instruments

	Water quality probe (YSI or equivalent)		Pump, tubing, reel, related supplies
	Calibration fluids, fresh		Pump converter/inverter (if needed)
	PID and calibration kit		Water level and/or Oil/Water indicator
	ASTM II deionized water		Generator (if needed)
	Turbidity Meter		Compressed air or air compressor (if needed)
	Disposable bailer, bailer twine		

Field Logs and Documentation

	Field activity daily log (if required)		Real time air monitoring log
	Groundwater elevation logs		COC
	Purge/Sample Logs		Site well map
	Sample Container Labels		Master sample data sheet
	Task-Specific Work Plan		Equipment list

Sample Supplies

	Poly sheeting		String for bailers
	Duct tape, Clear plastic tape		Tubing adapters and fittings
	Paper towels		Buckets and funnels
	Resealable baggies – all sizes		Appropriate sample bottles
	Coolers w/ice		Appropriate drums
	Sample preservatives		Graduated plastic container (liter)

STANDARD OPERATING PRACTICE TNFLD010C

Sample Labeling, Control and Shipping

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17.0 INTRODUCTION

The general objective of this SOP is to present procedures for sample identification (ID), sample control and chain-of-custody, and sample handling.

18.0 SAMPLE LABELING PROCEDURES

All sample identification, field records, and chain-of-custody records will be recorded in black waterproof, ballpoint non-erasable ink. Under no circumstances will “Sharpie” markers be used on field forms or chain-of-custody forms. If errors are made on any of these documents, personnel will cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the person performing the correction. If possible, all corrections should be made by the individual who made the error.

If information is entered using stick-on labels on sample tags, logbooks, or sample containers, subsequent removal of these labels should not be possible without leaving obvious indications of the attempt. Labels should never be placed over previously recorded information. Corrections to information recorded on stick-on labels should be made as stated in the previous paragraph.

18.1 Procedures

All soil, sediment, surface water, groundwater, waste, ambient air, and vapor emission samples collected will be labeled according to the following procedures.

15. Label each sample container with the following information:

- Date and time,
- Sample ID number,
- Project number ,
- Sampler (name), and
- Preservative .

16. Enter sample collection information in the field logbook. Begin the sample collection entry with the time at which the sample is collected (or collection is begun). Make the entry chronologically in the logbook (SOP No. 002A).

17. If no map of sampling locations is available prior to sampling, sketch a drawing of the site (not to scale) in the field logbook to provide an illustration of all sampling points. Provide measured distances from sampling points to a fixed reference point to allow accurate placement of sample locations on figures or maps.

19.0 SAMPLE NOMENCLATURE

The sample numbering scheme used for field samples and quality control (QC) samples is defined in the project-specific Sampling and Analysis Plan, Field Sampling Plan or comparable document.

20.0 CHAIN OF CUSTODY PROCEDURES

Chain-of-custody (COC) is a continuous possession of samples from their origin to completion of analysis and archiving/disposal in the laboratory. This uninterrupted possession is required to maintain integrity of samples. The chain-of-custody record is the documentation of this uninterrupted possession of the samples. The following procedures are recommended for ensuring preservation of chain-of-custody in the field:

- To simplify the chain-of-custody record and eliminate potential litigation problems, as few people as possible should handle the samples during the investigation.
- Each field team member is responsible for the proper handling and custody of the samples collected until they are properly and formally transferred to another person or facility. If the project has a Field Sample Coordinator (FSC), the field team will deliver all samples to the FSC as soon as possible, who then assumes responsibility for completing the chain-of-custody record.
- Prior to or immediately following sample collection, sample labels shall be completed for each sample container, using black waterproof, non-erasable ink, and affixed to the sample container. Labels should be affixed to each sample container and completely covered with a clear waterproof tape to prevent the labels from separating from the sample containers or water damage to the labels.
- Sample containers should be placed in resealable plastic bags before placement on ice to prevent moisture from contacting the sample jars, which could affect the legibility of the sample container labels.
- All samples collected (date, time of collection, sample ID, location and other information as necessary) must be documented in bound field logbook at the time of sample collection.

To complete the chain-of-custody and to maintain an accurate record of sample collection, transport, analysis and disposal, the following methodology will be used:

18. Samples will be accompanied by a chain-of-custody form at all times. A chain-of-custody record will be completed for all samples or materials collected. A separate chain-of-custody record will be utilized for each final destination or laboratory utilized during the inspection or investigation.
19. The chain-of-custody form will be used by personnel responsible for ensuring the integrity of samples from the time of collection until shipment to the laboratory.
20. The chain-of-custody record shall accompany all samples to the final destination. The original of the record will be placed in a sealed plastic bag taped to the inside top cover of the cooler. One copy of the record will be retained by the Field Sample Coordinator, and faxed to the Project Chemist and Project Manager. The original record will be transmitted to the Project Manager after samples are accepted by the laboratory. This copy will become a part of the project file.
21. The chain-of-custody form will be signed by each individual who has the samples in his or her possession.

22. The chain-of-custody form will be initialed in the field by the person collecting the sample, for every sample. If needed, several COC forms or COC continuation forms can be used to group samples under one COC. The continuation forms will reference the original COC number and all pages will be numbered.
23. The chain-of-custody will be completed in the field to indicate project, date, location, sampler, client, etc.
24. If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for "Relinquished by" and "Received by" will be completed in the field by the sampler and transporter, respectively.
25. The person transporting the samples to the laboratory or delivering them for shipment will sign the record form as "Relinquished by" at the time the samples are handed off to the laboratory (which will sign the “Received by” section).
26. If the samples are transported directly to the laboratory, the chain-of-custody form will be kept in the possession of the person delivering the samples.
27. If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form will be sealed in a watertight container, taped on the inside lid, and the shipping container sealed with custody seals (two on each shipping container) and tape prior to being given to the carrier.
    1. For samples shipped by commercial carrier, the waybill or air bill will serve as an extension of the chain-of-custody record between the final field custodian and receipt in the laboratory. The sender's copy of the waybill must be stapled to the sender's copy of the chain-of-custody form and filed with the original. The waybill tracking number must be entered into the logbook. Sample sender must sign with date and time as “Relinquished by” just before sealing coolers.
    2. Upon receipt in the laboratory, the sample recipient will open the shipping containers, compare the contents with the chain-of-custody record, ensure that document control information is accurate and complete, and sign and date the record as “Received by”. Any discrepancies will be noted on the chain-of-custody form.
    3. In the event of the discrepancies, the samples in question will be segregated from normal sample storage and the Project Chemist immediately notified.
    4. The chain-of-custody form is completed upon receipt of the samples by the analytical service laboratory. The completed chain-of-custody form will be returned to the Project Manager and maintained in the project file.

21.0 SAMPLE HANDLING PROCEDURES

21.1 General

Upon collection, all samples will be immediately placed on ice and taken to a proper location for packing, re-icing, and shipment. At all times, sufficient ice must be in the coolers to maintain a temperature of 4° C. All void spaces in the cooler should be filled with ice. Estimate no more than two to one ratio of samples to ice, except during hot weather when a one to one ratio should be used (e.g., one pound of ice per one pound of sample). This will insure samples are stored at the proper temperature.

21.2 Sample Packaging for Shipment

When preparing the samples for shipment to the laboratory, the following procedures will be employed:

1. Proper packing is necessary to ensure that samples arrive at the laboratory in good condition. The following protocol will be used for packaging of samples:

    1. Only waterproof metal or equivalent strength plastic ice chests and coolers will be used. Tapes that may emit VOCs will not be used within the container.

    2. Two large garbage bags or drum liners will be placed in the cooler to prevent leakage.

    3. Approximately 2 inches of inert cushioning material (vermiculite or similar absorbent material) will be placed in the bottom of the inner drum liner.

    4. All sample containers will be placed in clear, plastic, resealable (e.g. Ziploc ™) bags. Glass containers should be wrapped in bubble wrap or cushioning material to prevent breakage.

    5. Samples will be packed properly for shipment so that the bottles will not move around and/or break during shipment.

    6. Sufficient ice to maintain 4° C during shipment will be placed beneath, around, and on top of the sample containers. Additional cushioning materials will be added to prevent movement of samples during shipment.

    7. The chain-of-custody form will be placed in a resealable plastic bag and attached to the lid of the cooler with clear plastic packing tape. Laboratory name and contact, courier name(s), and other pertinent information will be recorded on the form.

    8. If the cooler is equipped with a drain plug, it will be taped shut.

    9. The completed shipping label will be attached to the cooler.

    10. "This Side Up" arrow labels will be placed on two sides of the cooler, and "Fragile" labels will be placed on all four sides.

    11. Numbered and signed custody seals will be placed on the front right and back left of each cooler. These seals will be covered with clear plastic packing tape.

    28. Samples will be transported by courier in an approved, cooled shipping container, ensuring that the maximum holding times between sample collection and analysis will not be violated. In general, all samples should be shipped priority overnight.

29. The weight limit of the shipper will be observed.

30. All records pertaining to the shipment of a sample will be retained in the project file (e.g., freight bills, post office receipts, and bills of lading).

21.3 Sample Shipment Considerations (Dot Regulations)

Samples in general can be classified in to hazardous materials/dangerous goods for shipment per DOT regulations. If we believe that the sample does not contain hazardous materials above reportable quantities or above TCLP hazardous characteristics, or above listed concentrations in the 40 CFR hazardous waste table including pH, corrosivity, and ignitability criteria, we can ship them regular, i.e. not under DOT requirements.

If the shipper believes that the sample contains a hazardous substance, for example chromium, then he/she should check reportable quantity (RQ) for chromium, TCLP for chromium, and sample pH (for liquid) and make a simple estimate of actual chromium content in the sample. Then add up all the chromium per cooler and see the requirements under DOT regulations for shipment of hazardous/dangerous goods shipment.

IF YOU ARE NOT DOT-TRAINING CERTIFIED, YOU CANNOT SHIP HAZARDOUS MATERIAL/DANGEROUS GOODS. To do so risks <u>large fines against the individual who signs the shipping bill.</u>

For some chemicals and compressed gases, the quantity, limitations, shipment requirements are all given in 49 CFR 172.101, especially in the Hazardous Materials Table 172.101. <u>Field personnel cannot classify samples based on the source or origin according to these regulations</u>. The shipper is supposed to know something about actual or expected chemical concentrations of the material in the shipping container. Field personnel who are unsure about shipping anything from the field should call a qualified person in the office and have the regulations reviewed for each situation.

22.0 REFERENCES

Department of Transportation, Final National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Laboratory Samples, March 1981.

United States Environmental Protection Agency Region 4, Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

STANDARD OPERATING PRACTICE TNFLD011A

Decontamination Procedures

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STANDARD OPERATING PRACTICE TNFLD011A

Decontamination Procedures

1.0 INTRODUCTION

The cleaning procedures outlined in this SOP represent standard decontamination procedures to be used by TN&A for all sampling equipment that may come into contact with contaminated media. Disposable sampling equipment will be used as much as possible to minimize the need for decontamination.

Alternative field decontamination procedures must be approved by the TN&A project manager ore designee and recorded in the field logbooks.

Cleaning procedures are described for two types of equipment:

- **Non-sample contacting equipment** - related equipment associated with the sampling effort, but that does not directly contact the sample (for example, drilling bits, soil field-screening jars, and flow-through cell).
- **Sample-contacting equipment** - equipment that comes in direct contact with the sample or portion of sample that will undergo chemical analyses or physical testing (for example, split-spoon or pond dipper).

2.0 GENERAL REQUIREMENTS

2.1 Cleaning Materials

<u>Detergent:</u> The laboratory detergent will be a standard brand of phosphate-free laboratory detergent such as Liquinox®. The use of any other detergent must be justified and documented in the field logbooks. This detergent must be kept in a clean plastic, metal, or glass container until used.

<u>Tap Water:</u> A potable water source (tap water) will be identified and tested for use for equipment decontamination procedures as part of the field pre-planning activities. The use of tap water for cleaning equipment is not acceptable unless it has been tested and found to be non-contaminated for all project target analytes. Tap water may be from an on-site or off-site source and is typically the project site municipal water supply source. Tap water can be stored in clean tanks, sprayers, or squeeze bottles or may be applied directly from a tap water source.

<u>Deionized Water:</u> Deionized water is defined as tap water that has been treated by passing through a standard deionizing resin column. ASTM Type II deionized water will be laboratory-certified to contain no heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard Inductively Coupled Plasma (ICP) scan. Deionized water must be stored in clean glass, stainless steel, or plastic containers.

During cleaning operations, the substitution of a higher grade water (e.g., deionized or organic-free water for tap water) is permitted and need not be noted as a variation of this SOP.

Alcohol, Acids and Solvents: Isopropanol, nitric acid, hexane are typical additional cleaning fluids that may be used to clean field equipment. The project-specific Sampling and Analysis Plan (SAP or comparable document) should specify if these materials are to be used. Observe all DOT shipping requirements for these materials.

2.2 Safety Procedures to be Used During Cleaning Operations

The materials used to decontaminate equipment can be dangerous if improperly handled. Caution must be exercised by all personnel and all applicable safety procedures shall be followed. At a minimum, the following precautions shall be taken in the decon area and in the field during cleaning operations:

- Safety glasses with side shields or goggles and nitrile or latex inner gloves will be worn at all times during all cleaning operations. All other site-specific health and safety requirements must be met for workers in contact with contaminated or potentially contaminated equipment.
- Steam cleaning will generally be performed by a TN&A subcontractor who is responsible for compliance with their own health and safety requirements for this task.
- Eating, smoking, drinking, chewing, or any hand-to-mouth contact shall not be permitted during cleaning operations.

2.3 Storage of Field Equipment

All field equipment shall be stored in a contaminant-free environment after being decontaminated. For example, clean field equipment will not be stored near fuel sources or within in the exclusion zone. Equipment will be moved upwind of the decontamination area and allowed to air dry. The dry equipment will then be wrapped in plastic or aluminum foil. Larger equipment will be wrapped in plastic sheeting until used. Cleaning solutions must be stored as described in Section 2.1.

3.0 QUALITY CONTROL PROCEDURES FOR CLEANING OPERATIONS

This section establishes guidelines for specific QC procedures to monitor the effectiveness of the sampling equipment cleaning procedures. All QC procedures will be recorded in the field log books.

3.1 Equipment Blank Samples

The effectiveness of the equipment cleaning procedures shall be evaluated by rinsing cleaned, non-dedicated sampling equipment (e.g., submersible pumps, pond dipper) with ASTM Type II or equivalent laboratory grade organic-free water. The rinsate samples will be collected and submitted for laboratory analysis in accordance with the project-specific SAP. Select different pieces of equipment for this procedure each time equipment is washed, so that a representative sampling of all equipment is obtained during field activities.

The following procedures will be used to collect an equipment rinsate blank:

31. Complete the cleaning procedures listed in Section 4.0 of this SOP. If the rinsate blank is collected from a submersible pump, be sure to rinse the sample contact portion of the disassembled pump with deionized water.
32. Fill laboratory-supplied containers with laboratory-grade water rinsate. Refer to the project-specific SAP for sample analyses to be performed on the rinsate blank. The project-specific QAPP will provide the number of sample containers and preservatives needed.
33. Follow the project-specific SAP for sample nomenclature for QC samples.

4.0 CLEANING REUSABLE SAMPLE-CONTACTING EQUIPMENT

As noted in Section 1.0 of this SOP, efforts will be made to use disposable sampling equipment to minimize the potential for cross contamination. However, when sample-contacting equipment is reused, such as the pond dipper, the procedures outlined in this section shall be followed.

4.1 General

Equipment decontamination will take place in designated "decon" area within the Contamination Reduction Zone (see project-specific health & safety plan) that is lined with plastic. All equipment decon waters will be retained and containerized as specified in the project-specific SAP. The detergent and rinse water baths may be reused but new solutions must be prepared periodically, depending on the amount of equipment requiring decontamination.

4.2 Equipment Used to Collect Sample for Organic Analyses

The following procedure will be used when cleaning metallic, Teflon®, plastic, or glass field sampling equipment:

34. Wash equipment thoroughly with laboratory detergent (e.g., Liquinox®) and water using a brush to remove any particulate matter or surface film. When cleaning plastic sampling equipment, care should be taken to avoid scratching the equipment.
35. Rinse equipment thoroughly with tap water.
36. Rinse equipment thoroughly twice with deionized water.
37. Allow equipment to air dry as much as possible.
38. Wrap equipment in plastic or aluminum foil.

4.3 Sampling Equipment Used to Collect Samples for Inorganic Analyses

The following procedure will be used when cleaning field equipment used for the collection of samples for metals and other inorganic analyses:

39. Wash equipment thoroughly with laboratory detergent (e.g., Liquinox®) and water using a brush to remove any particulate matter or surface film. When cleaning plastic sampling equipment, care should be taken to avoid scratching the equipment.
40. Rinse equipment thoroughly with tap water.
41. Rinse equipment using a 0.1 N nitric acid.
42. Rinse equipment using distilled water.
43. Rinse equipment using a pesticide-grade solvent (hexane).
44. Rinse equipment thoroughly twice with deionized water.
45. Wrap equipment in plastic.

4.4 Cleaning Procedures for Tubing

If tubing is not dedicated to a specific well during well development and/or sampling activities, the following tubing cleaning procedures will be used to clean tubing in between sampling locations. The tubing must be of an inert material such as Teflon or may be bonded poly Teflon-line tubing for this procedure. Note: this procedure is cumbersome and time-consuming and may not be practicable for long-lengths of tubing.

Set up three large tubs for the detergent wash, tap-water rinse and deionized water rinse of the tubing. Place all of the tubing in the detergent bath. Using a pump (down-hole pump or peristaltic pump may be used for this procedure), pump the detergent-wash water through the tubing for several minutes. Remove tubing and pump and place in rinse bath and repeat pumping procedure. Change rinse water in between cleaning tubing from different wells. Remove tubing and pump and place in deionized water rinse tub and repeat pumping procedure. Collect rinsate samples at this time (Section 3.1). Place clean tubing in a large plastic bag (e.g., a 55-gallon drum liner) and wrap pump in plastic or aluminum foil.

4.5 Sampling Equipment Contaminated with Gummy or Oily Materials

In cases where reusable-sampling equipment (such as an oil-water interface probe) is used and contaminated with highly adhesive, gummy or oily materials, additional decontamination procedures using special solvents may be required. If this is required, special decontamination steps will be implemented between Steps 2 and 3 of Section 4.2.

If sampling equipment is used to collect samples that contain oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with isopropanol to remove the materials before proceeding with Step 1 of Section 4.2.

In extreme cases, when equipment is painted, badly rusted, or coated with materials that are difficult to remove, it may be necessary to steam clean, wire brush, or sandblast equipment before proceeding with Step 1. Any sampling equipment that cannot be cleaned using these procedures will be discarded as IDW and will be managed in accordance with SOP No. 012A.

5.0 SPECIFIC EQUIPMENT CLEANING PROCEDURES

5.1 Water Level Indicators

The following procedures apply to cleaning water level indicators and other sounding equipment. Because a water level indicator may be in contact with groundwater that will be sampled, it is considered sample-contacting equipment. Personnel shall clean water level indicators in accordance with these procedures between each well.

46. Wash equipment thoroughly with laboratory detergent and water using a brush to remove any particulate matter or surface film.
47. Rinse equipment thoroughly with deionized water.
48. Allow equipment to air dry as much as possible.
49. Wrap equipment in one layer of aluminum foil (at the end of the day).

5.2 Bladder Pumps

Decontamination procedures, which are described in the manufacturer’s literature, should be followed as much as is practicable. Because a pump is in contact with groundwater that will be sampled, it is considered sample-contacting equipment. The following steps provide generalized decontamination procedures for bladder pumps:

50. Pump a sufficient amount of soapy water through the pump to flush out any residual purge water.
51. Using a brush, scrub the exterior of the contaminated electrical supply/control cables, air hose, and pump with hot soapy water. Rinse the soap from the outside of each with tap water. Next, rinse each with deionized water and recoil onto the spool.
52. Pump a sufficient amount of tap water through the pump to flush out soapy water. Disassemble the bladder pump by unscrewing the screened portion of the pump casing, and removing the bladder. Rinse the outside of the bladder and the inside of the pump casing with soapy water, then rinse with tap water.
53. Rinse the outside of the bladder and the inside of the pump casing with deionized water. Reassemble the pump and pump a sufficient amount of deionized water through the pump to flush out the tap water.
54. Rinse the outside of the pump, air hose, and electrical supply control cables with deionized water.
55. Place the equipment in a polyethylene bag or wrapped with polyethylene film to prevent contamination during storage or transit.

5.3 Portable Power Augers

Portable power augers may be used during installation of passive soil gas sampling devices. Soil samples will not be collected for chemical analysis from the soil gas survey sampling points, therefore the augers are considered to be non-sample contacting equipment.

56. The engine and power head will be cleaned with a power washer, steam jenny, or hand washed with a brush using detergent (does not have to be laboratory detergent but will not be a degreaser) to remove oil, grease, and hydraulic fluid from the exterior of the unit. These units will be rinsed thoroughly with tap water followed by deionized water.
57. All auger flights and bits shall be cleaned by a pressure washer capable of producing water at 200°F and 1,500 psi before borehole entry and will remain clean until installed in the borehole.

5.4 Drilling Rigs

A decontamination pad will be constructed on-site prior to beginning any drilling rig or drilling equipment decontamination procedures.

Drilling equipment will be decontaminated prior to the commencement of drilling activities. Drilling rig will be decontaminated between boreholes and care should be taken to reduce mud tracking.

The drilling subcontractor will be responsible for conducting proper decontamination of drilling equipment. Drilling equipment in contact with the subsurface will be placed on racks or saw horses at least 2 feet above the floor of the decontamination pad and steam cleaned with high pressure hot water. Persistent particulate matter or surface films will be removed with tap water and phosphate-free detergent, scrubbing, and a tap water rinse. Drill rods that are hollow or have holes that transmit water or drilling fluids will be cleaned on the inside with vigorous brushing, detergent, and steam cleaning, followed by a tap water rinse.

After completion of decontamination, the equipment will be removed from the decontamination pad and covered with clean new plastic until the equipment is used again. If stored overnight, the plastic will be secured to ensure that it stays in place.

Water used during the decontamination process will be pumped into 55-gallon drums and stored on-site until proper disposal procedures can be conducted.

Upon completion of all drilling activities, any drilling equipment that contacted subsurface materials will be decontaminated prior to the departure of the drilling equipment from the site.

5.5 Flow-Through Cell

The water quality meter and flow-through cell are non-sample contacting equipment. The sonde will be removed from the flow-through cell prior to decontamination. The flow-through cell will be disconnected from the associated sample tubing. The flow-through cell will be submerged in soapy water, while samplers use their hands to cap the ends of the cell. (Note: samplers must wear disposable latex or nitrile gloves during decontamination). The soapy water should be agitated in the cell; samplers should use their fingers to dislodge any remaining sediment (stiff brushes should not be used in the flow-through cell to prevent scratches). This procedure will be repeated with tap water. The flow-through cell will be rinsed thoroughly with deionized water, and stored in a resealable gallon-sized plastic bag.

5.6 Field Analytical Equipment and Other Field Instrumentation

Decontamination of field analytical equipment and other field instrumentation will follow the respective manufacturer's recommendations.

The exterior of sealed, watertight equipment will be washed with a Liquinox® solution and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary. Other field instrumentation will be wiped with a clean, damp cloth. Conductivity probes, pH meter probes, DO meter probes, etc., will be rinsed with deionized water before storage.

The turbidity meter sample cuvette will be cleaned and dried with a soft cloth, to prevent scratching of the sample cuvette. The desiccant in flow meters and other equipment will be checked and replaced if necessary each time the equipment is cleaned.

5.7 Ice Chests and Shipping Containers

All ice chests and reusable containers shall be washed with laboratory detergent (interior and exterior) and rinsed with tap water and air dried before use. In the event that an ice chest becomes severely contaminated, in the opinion of field personnel, it shall be cleaned as thoroughly as possible, rendered unusable, and properly disposed as IDW.

6.0 DECONTAMINATION FLUID CONTAINMENT

All decontamination liquids will be containerized in DOT-approved 55-gallon drums. Drums will be labeled according to the procedures specified in the project-specific SAP and TN&A SOP No. 012A and stored in the designation IDW container storage location at the site.

7.0 REFERENCES

ASTM, September 1990. *Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites*, D 5088-90

U.S. Environmental Protection Agency Region IV. May 1996. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, Environmental Services Division